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"CONTROLLING SEX IN BUTTERFLIES."

BY CHAS. V. RILEY, M.A.

THE article with the above title by Mrs. Mary Treat, in the March number of the NATURALIST, has attracted a good deal of attention, and most naturalists will be proud that a lady has set the example of making such investigations. But while I fully concur with the authoress in the deduction that the female in insects and especially in Lepidoptera, "requires more nourishment than the male," I cannot follow her in the other conclusion "that sex is not determined in the egg of insects." Were this conclusion well founded it would upset what most physiologists of note believe to be a fundamental principle, viz., that, in the individual, sex is determined at the moment of conception, no matter at what stage of growth it becomes ascertainable by us. That such is the case with the higher animals will scarcely be doubted, and to reason from analogy that it is the case with the whole animal kingdom is quite as natural, though equally as unsafe, as it was in years gone by to argue that *lucina sine concubitu* was an impossibility; or that larval reproduction, in insects, could not possibly take place. It is, therefore, worth while to weigh the evidence for and against the possibility of controlling sex in larvæ.

Mrs. Treat, whom I know to be a good observer, and whom I esteem as a correspondent, had already, in 1871, communicated to me her belief that she could control the sex in butterfly larvæ,

and though I then gave her my opinion that her experiments were by no means satisfactory and conclusive, for the reason that many of the larvæ experimented on died, we find her discoursing in the following unqualified manner in "Hearth and Home" for January 13, 1872, in treating of *Papilio asterias*:—

"When the worms become of the right size cut off their supply of food, and every one will produce a male butterfly! On the other hand even after they have left their food-plant and selected their place to change to the chrysalis, disturb them, make them leave their place, and coax them with a fresh supply of their favorite food, and continue to feed them for about two weeks longer, and all will be females!"

Led by Mrs. Treat's observations to test the question, I last summer conducted a few experiments which resulted very differently from those recorded in the article referred to, and which, after briefly reviewing the article, I will detail. In waiting for some of these results I have been obliged to defer writing this article till the present time.

In the first experiment with *Papilio asterias*, mentioned by Mrs. Treat, some of the larvæ died, and we are not told whether the number experimented with was large or small.

In the experiment with the same insect in 1872 we are told that of seventy-nine specimens that had been labeled males (a few chrysalides having died) three females only were produced. On the other hand those that were well "fed up" and labeled females, produced sixty-eight females and four males. The original number so labeled is not given and it is not stated whether any chrysalides failed to produce the imagines; so that we are left to infer that seventy-two were experimented with and that they all produced the butterfly — a success in rearing which is remarkable.

In the third experiment with twenty larvæ, nine females and eight males were produced, the other three failing.

In the experiment with *Vanessa antiopa* more than half the larvæ died, and in the trials with *Anisota rubicunda* some also died and were parasitized.

Now *Papilio** deposits its eggs singly, and from experience in breeding *asterias*, *Troilus*, *Turnus* and *Ajax*, from the egg, I am satisfied that it would be very difficult to get any great number to hatch on the same day or to become chrysalides or

* I use the term in the old, and not in Mr. Scudder's, sense.

imagines on the same day. The eggs must have been gathered singly, or the larvæ of different ages taken on the same day, or of the same age on different days. Of a given number thus gathered I should expect the sexes to be about equally divided, and we in reality find that of the one hundred and seventy-one larvæ, particularly mentioned, the sexes are almost equally proportioned in number, eighty-eight males and eighty females having been obtained and a few chrysalides (which, as we shall presently see, would most likely be females) perishing.

In *Anisota*, on the contrary, the eggs are deposited in batches and it is more easy to get a number of larvæ of the same age. Mrs. Treat's experience with her thirty-three larvæ is quite opposed to mine with the same species.

Mrs. Treat does not tell us whether she did or did not use any discretion as to the size in selecting her intended males and females, and this is a very serious omission, as by the criterion of size alone among larvæ of the same age, the sexes in many species may be separated with considerable certainty. I regret also that she has not specified at what age, and whether always at the same age, the treatment of "feeding up" and "shutting off" was begun, though we may infer, from what is said, that it was after the last larval molt.

Mrs. Treat speaks of keeping larvæ eating beyond the period of pupating, or rather of preparation for that change, and of "starving" them, as though there was hardly any limit to these processes. Analyzed, what meaning do these expressions convey? Very little. They are deceptive! Most Lepidopterous larvæ, in a state of nature would come under the head of "feeding up" as they usually have an ample supply of food at command, and eat their fill. While, therefore, it is perfectly possible to stunt such larvæ by furnishing them with a scant supply of food, and thus to prolong the period and diminish the amount of their development, it is utterly impossible, in the great majority of cases, to get them to eat after they once commence to prepare for the chrysalis state. This is my firm conviction after ten years of pretty extensive insect-rearing, and I think that most experienced insect-raisers will agree with me. If disturbed after preparing to pupate, most larvæ will repeatedly renew similar preparations, but if too often frustrated they will either transform without the proper preparation or die. They are, doubtless, prompted to forsake their food and

prepare for the transformation by the changes already taking place in the system, and in the great majority of cases the mandibulate is already giving way to the haustellate mouth, and has become impotent to perform its wonted labor. Larvæ can neither be forced nor stuffed beyond a certain limit, and this limit is attained by every well fed larva in a state of nature and in the vivarium, so that if Mrs. Treat's theory had any real foundation almost all insects that were not "starved" ought to be females. A high temperature will cause rapid development, but it does not cause a greater aggregate amount of feeding.

But to my own experiments: Of the six insects chosen, the sexes in some differ in the most remarkable manner, while all show sufficient disparity to render mistakes in separating the sexes impossible. They are, also, all common in this section, so that others will have no difficulty in verifying my facts. Except in the case of *Thyridopteryx* I made no attempt to "feed up;" my efforts all being in the direction of "starving," or, as Mrs. Treat would put it, of producing males. Neither have I relied entirely on my own observation; for, being necessarily absent from home, at intervals, the experiments, with explicit directions, were at such times left in charge of Mr. Otto Lugger and Miss Mary E. Murtfeldt, both well practised in rearing Lepidoptera. I would also premise that the stunting process began from the time of hatching, and that it was carried so far that, of the less hardy species, many died under the treatment. It was, also, especially enforced towards larval maturity. The species chosen were, 1. *Thyridopteryx ephemeræformis* (Haw.); 2. *Orgyia leucostigma* (Sm. and Abb.); 3. *Clisiocampa Americana* (Harr.); 4. *Hyperchiria Io* (Fabr.); 5. *Hemileuca Maia* (Drury); 6. *Anisota rubicunda* (Fabr.).

1. *Thyridopteryx ephemeræformis.*—Two lots: lot 1 consisting at first of between thirty and forty individuals, and abundantly and constantly nourished; lot 2, of thirty individuals and very poorly nourished or "starved." From lot 1, twenty-eight cocoons were obtained, of which fifteen were males and thirteen females, all of them attaining the imago state. From lot 2, eighteen cocoons were obtained, which produced twelve males and six females, two of the females failing to perfect and dying in the chrysalis state, in which the sex is readily determined. The stunted lot produced, on an average smaller specimens, and were later in developing, the first male appearing September 15th

against September 10th, on which day the first male in lot 1 appeared. Some of them, however, were of the usual size.

Besides these two lots which were in small vessels and very strictly watched, I had a great number in a large breeding cage, which were so thoroughly neglected that fully one-half died. No accurate account was kept of them but of upwards of fifty chrysalides obtained, fifteen were females. This is a tough insect and will stand very rough treatment, and the last-mentioned were repeatedly allowed to wander around the cage for three days or more without a particle of food.

2. *Orgyia leucostigma.*— Started with a lot of forty, which were very carefully watched and very insufficiently fed. From them eighteen cocoons were obtained, ten of which were actually females and eight males. I naturally looked for a different result in this case as there is a very perceptible difference in the size of the sexes, and the female larva grows one-third larger than the male requiring, in consequence, a greater amount of nourishment. I had also noticed in previous rearing of this species that the males often passed through but three larval molts, while the females passed through four; but to show that the number may vary in the same species, according to circumstances, Miss Murtfeldt assures me that under this stinting process the former went through four molts like the females. Similarly, Prof. Westwood has informed me that a larva of *Megatoma* [*Tiresias*] *serra* which he once kept on flies and insufficiently fed, lived for three years and molted no less than fourteen times.

3. *Clisiocampa Americana.*— Started with a batch of upwards of fifty just hatched. Obtained only nineteen cocoons from them, the rest dying from hard treatment. Five small females and nine males were obtained, the others dying in chrysalis.

4. *Hyperchiria Io.*— Twelve taken from Baptisia soon after the fifth or last molt. Furnished very stintingly with food. All pupated. Two male moths issued in the fall; four males and three females this spring, three being yet in the chrysalis state. At the same time I had two other lots feeding, with ordinary care, on Sassafras and Amorpha, and in both lots the males have so far preponderated.

5. *Hemileuca Maia.*— One brood of upwards of one hundred from an egg-belt fastened around a peach twig. Endeavored to feed them on peach leaves, which were not to their taste, until

more than half had died. Stinted the rest as much as possible until only thirty-two entered the ground. Of these fifteen produced males and eight females, the rest being yet chrysalides.

6. *Anisota rubicunda.*—About fifty larvæ of all ages, of the first brood, and badly stinted, gave twenty-two chrysalides; and these gave eleven females, seven males—the rest dying. Upwards of a hundred, hatched from eggs deposited in confinement by one of the above females and likewise stinted, gave fifty-six chrysalides.

I watched these with a good deal of interest, as, from the necessarily weakened condition of the parents, I expected a large proportion of males; but I was doomed to disappointment, as but three moths — two females, one male — issued on the 21st and 22nd of May. In examining the remaining chrysalides I find them all dead, and I cannot help thinking that this excessive mortality is attributable to the stinting process they endured as larvæ, more than to any other cause, as the earth containing them was kept in the best condition.

While these experiments were being carried on I had many hundreds of the common silkworm (*Bombyx mori*) feeding on Osage Orange (*Maclura aurantiaca*) a great number of which succeeded admirably out-doors under netting, and others in-doors. Two of the lots in-doors were fed sparingly and not well cared for. No precise records were kept, and very many died; but of the imagines obtained I recollect very well there was no disproportionate number of males.

On the whole, if these experiments indicate anything, they indicate that where more males than females are obtained from stinted larvæ, it is attributable to the fact that the females, being largest and requiring most nourishment, succumb most readily under such treatment; rather than that the sexual characteristics are modified and determined by such treatment. Mrs. Treat's facts are, in some respects, remarkable, but, bearing in mind the influence of the condition of the parents on the sex of the offspring, it will not do to draw conclusions too rashly; for every experienced entomologist knows that occasionally, in a particular brood of larvæ, one sex or the other will greatly preponderate, where no especial treatment was followed in the rearing.

While, therefore, I do not think that the facts yet in our possession, warrant the belief that the quality or amount of food has

any influence in determining sex in the individual once out of the egg, I do believe, with Thomas Meehan, Henry Hartshorne and others, that there is a certain relation between organic vigor and sex, and that the latter may be determined in the offspring by the amount of vigor or vitality — creative or organic force — in the parents, and that the female is in some way connected with increased, and the male with lessened, vitality; for strong arguments may be adduced in favor of such a belief.* Certain curious facts in the natural history of some of our gall-making *Cynipidæ* lend singular weight to these views. From these facts, ascertained by Mr. H. F. Bassett of Waterbury, Connecticut, there can be little doubt that many of the species produce two distinct kinds of galls, alternating with each other, the one vernal, the other autumnal. The former produce flies with a due proportion of the sexes, and the latter produce nothing but large females.† In other words, the directly fecundated and more highly vitalized ova produce nothing but large females, while the parthenogenetic offspring is smaller and composed of both males and females.

The curious facts, as now understood, in the economy of the common hive-bee, seem at first to militate against the conclusion that food has no influence on the sex of larvæ, but in reality they do not, though they indicate that the sex may be altered or determined after partial or imperfect conception has already taken place. All eggs not directly impregnated produce drones or males (*not females*, as "*A. S. P.*," by a singular lapse of thought, has stated on p. 177 of the March number of the NATURALIST), while

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* See AMERICAN NATURALIST, vi, pp. 632, 747, and Missouri Entomological Reports, iv, p. 65 and v, p. 85.

† To give a single illustration: A large wool gall—the modification and deformation of a bud—is tolerably common on our black oaks. The flies produced from it (*Cynips q. operator*) are bisexual. Mr. Bassett has witnessed the female depositing in acorns of the same trees on which the wool galls occur. The product of these eggs is a pip-like gall (the *C. q. operatola* of my manuscript) which develops between the cupule and the fruit. It is quite irregular in form, but with the apical end tapering more or less to a point and the basal end rounded. It is greenish when young, yellowish when mature, and the larva rests in a cream-colored ovoid cell, easily freed from its pip-like covering. This gall is generally numerous enough to render the acorns abortive, and I have known it since 1869. In August, 1871, while visiting Mr. Bassett, I collected a number from *Quercus ilicifolia*, and brought them home in the hope of rearing the flies from them. This spring, after a lapse of about twenty months, and just as the oak buds were bursting I succeeded in obtaining a number of flies, every one of them females and agreeing with *C. q. operator* except in being larger. Singularly enough this very year Mr. Bassett succeeded for the first time in finding the producer of the woolly gall, *C. q. operator*, ovipositing in buds; and his description leaves no doubt that the flies he thus discovered are identical with my bred specimens.

those which are impregnated at the will of the mother produce females either partly or fully developed, *i.e.*, workers, or queens. The rule with animals is that the ova perish unless vitalized by the direct influence of the male spermatozoa. Nevertheless parthenogenesis in many of the lower forms of animal life, and especially in insects, is an admitted fact; and what does it imply? To my mind it implies that in exceptional cases, the male element is sufficiently potent to vitalize the ova in the second generation, or that it may endure until succeeding generations; that, in short, to use Owen's words, "the spermatic virtue of the ancestral coitus" may influence the descendants. Von Siebold does not accept this explanation, but there are many facts which indicate that it is the true one, and the male element becomes exhausted in time and is needed sooner or later for the continuance of the species.

Parthenogenesis has repeatedly occurred in species which normally cannot multiply without direct sexual intercourse, *e. g.*, in *Bombyx mori*, *Sphinx ligustri*, etc.; while in a great number of others the embryo, in eggs not directly fecundated, develops up to different stages. What in some species is the exception becomes the rule with others, of which the hive-bee is an example. The male element may be said to possess all degrees of potency in its influence on the reproductive function of its immediate issue, as the embryo in ova not directly fecundated attains all degrees of development before death. In cases of parthenogenesis it is potent enough, vital enough—to cause full development of the offspring for one or more generations, though, in the majority of instances, and especially where this mode of reproduction does not occur as a rule, this offspring is most frequently male. Finally, it may be so potent, as in what is termed thelotoky, that females instead of males are produced.

The ova in a virgin queen bee may, therefore, be said to be already partially fecundated—sufficiently so to produce males or drones; but they must be more thoroughly vitalized, by the direct male influence, before the female sex can be stamped upon them. Even here, however, the sex is not changed after the deposition of the eggs, and it is not the influence of food which produces the change.

Though I believe that the evidence is against Mrs. Treat's conclusion, I hope she will continue her experiments, with that thor-

oughness and exactness of which she is capable. Nature's contrivances for the maintenance of life in all its wonderful and varied phases are inexhaustible, and we are ever laying down rules and theoretical laws, only to find them violated and upset, as we more truly interpret her ways. She is as watchful of the myriad invisible atoms that mantle o'er the pond with green, or of the unseen swarms that fill the air "though one transparent vacancy it seems," as she is of the higher forms of life. Plastic, she conforms in every conceivable and inconceivable way to the wants of her immense family. She shows us

> "The ant's republic and the realm of bees;
> How those in common all their stores bestow,
> And anarchy without confusion know;
> And these forever, tho' a monarch reign,
> Their separate cells and properties maintain,"

and calls loudly on us to read aright and solve her yet many untold secrets.

THE FLORA OF THE DISMAL SWAMP.

BY PROF. J. W. CHICKERING, JR.

A few notes of a recent botanical trip to the Dismal Swamp, that romance of our geographies and Moore's ballad, giving its characteristic flora, with the species found in flower, may not be wanting in interest.

Sunrise, on the morning of April 11th, found our party of two, Mr. William H. Seaman of Washington, and myself, just ready to make the landing at Old Point Comfort. A stroll before breakfast, for a mile or two along the sandy point, brought us to small groves of pitch pine (*Pinus rigida*), interspersed with thickets of dwarf live oak (*Quercus virens* var. *maritima*), here reaching its northern limit, while inside the fortress the true live oak attains quite a large size. The prickly pear (*Opuntia vulgaris*), is scattered along the sand, and on one almost inaccessible edge of the rampart displays its reddish fruit. Along the ramparts occur the bright blue spikes of the grape hyacinth (*Muscari botryoides*), with *Lamium amplexicaule*, *Sisymbrium Thaliana* and *vicia*. A walk of a couple of miles to Hampton

reveals nothing of special interest, *Viola cucullata* and *primulæfolia* being the only species noticed. The suburbs of Norfolk abound with pride of China (*Melia azedarach*), still retaining its whitish drupes, three or four species of magnolia and other distinctively southern trees, while *Yucca gloriosa* flourishes most thriftily on heaps of garden rubbish.

The next morning a little steamer received us for our trip, up the Elizabeth River, through the Dismal Swamp Canal, and down the Pasquotank River, to Elizabeth City, N. C., forty miles in all.

The swamp region is of indefinite extent, being estimated at from six hundred to one thousand square miles, thirty miles or more from north to south, and twenty or more, from east to west. Much of it has been cleared and partly drained, here and there a clearing of several hundred acres meeting the eye, said to be capable of producing fifty bushels of shelled corn to the acre, while at rare intervals appear neat, white and inviting mansions.

It seems originally to have been heavily wooded. The cypress (*Taxodium distichum*), juniper (*Juniperus Virginiana*), tulip tree (*Liriodendron tulipifera*), and the sweet and sour gums (*Liquidambar Styraciflua* and *Nyssa uniflora* and *aquatica*), are abundant and attain a large size.

Most of the large trees, however, have been cut off, or have fallen victims to the frequent fires, several of which were raging during our visit, and lighted up the horizon at night; often by these fires, the peaty soil for miles is burned to the depth of four or five feet; the hollow thus formed soon fills with water, and ever after retains a truly "dismal" appearance. But, for the most part, the swamp exhibits almost tropical luxuriance, the true canebrake almost forbidding passage. The foliage at this season is largely evergreen, the maples being only partially in leaf and the cypress but beginning to put forth its delicate leaflets. *Ilex glabra*, inkberry, or, as it is called there, gall-berry, is the most abundant shrub, especially along the watercourses, occurring, from two to ten feet in height, its black berries contrasting finely with its glossy leaves. The sweet bay (*Magnolia glauca*), the holly (*Ilex opaca*), often with its scarlet berries, the great laurel (*Rhododendron maximum*), and perhaps loblolly bay (*Gordonia Lasianthus*), are very abundant; while climbing high over all is the *Smilax laurifolia*, with its large, stout, evergreen leaves, appearing as if pinnately compound, and lower down the green-brier (*S.*

rotundifolia), weaving almost impassable barriers with its tough prickly stems, also *Myrica Gale*, and *Leucothöe Catesbæi*. But most beautiful of all, at this season, is the yellow jessamine (*Gelsemium sempervirens*), twining around trees to the height of twenty or thirty feet, covering thickets, hanging in festoons from the branches, and throwing out everywhere its racemes of golden yellow blossoms, loading the air with its fragrance. It has but one drawback, the frequent tendency of its perfume, in a close room, to cause headache and other disagreeable symptoms.

Of deciduous trees and shrubs, just opening, we noticed *Acer rubrum* and *dasycarpum*, horse-sugar, *Symplocos tinctoria*, a beautiful shrub, worthy of cultivation, *Pyrus arbutifolia*, *Quercus salicifolia*, and very abundantly *Rubus villosus*, with two or three species of *Vaccinium* and *Gaylussacia*. Along the canal banks, and at times, in large masses, forming almost impenetrable canebrakes, from two to twenty feet in height, we found *Arundinaria gigantea* and *tecta*, being fortunate enough to detect the former in flower, on the shorter stems. This is a most troublesome weed in the clearings, its matted roots resisting everything but fire or a breaking-up plough.

Leaving the steamer and paddling three miles up a smaller canal to Lake Drummond, we met with *Osmunda regalis*, *Claytoniana* and *cinnamomea*, in great abundance and luxuriance; also *Typha latifolia*, *Nesæa verticillata*, great quantities of *Saururus cernuus*, *Onoclea sensibilis*, *Mitchella repens*, *Viola primulæfolia* and *Orontium aquaticum*, only the last two being in flower. The lake is about six miles long by four wide, and is so bordered by cypress swamp, that except in a boat no access to it can be had. The water is as dark as brandy, but not unpalatable nor unhealthy. Fish are quite plenty. We saw no animals, though foxes, "possum" and "coon" are plenty, and bears and deer are seen occasionally. Birds too are scarce; now and then a turkey buzzard sails slowly overhead, or a hawk starts up from an old stump, or a flock of crows wind their noisy way from wood to cornfield, but very few of the sparrows or flycatchers or other cheerful occupants of ordinary woods meet the view. For the most part silence and solitude reign supreme.

Around Elizabeth City, the ground is dry and the soil good, and we found in addition to species already enumerated *Senecio tomentosus*, *Asarum arifolium*, *Ranunculus pusillus* and *bulbosus*,

Anemone nemorosa, *Arabis lævigata*, *Barbarea vulgaris*, *Callitriche verna*, *Proserpinaca palustris* and *pectinacea*, *Hydrocotyle umbellata*, and *Sagittaria*. On the trunks of the fine elms along the streets is found, very abundantly, *Polypodium incanum*, its root-stocks creeping over the bark, and covering them with its delicate fronds to a height of twenty feet. Though apparently dry and dead, upon being brought home and placed in a fernery, the fronds began to expand and some new ones were seen putting forth. A later trip would doubtless reveal many more species, but with the drawback of possible chills and certain yellow flies and mosquitoes.

INJURIOUS AND BENEFICIAL INSECTS.

BY A. S. PACKARD, JR.*

THOUGH the reporter was absent during most of the past season, and was unable, except in a slight degree, to make any special investigations on the habits of our more injurious insects, yet with the help of others some new material is here offered that may be serviceable to farmers and gardeners. The facts that we have to present may often seem disconnected and desultory, but few except experts in natural history are perhaps aware how difficult and prolonged a task it is to follow out the transformations of any particular insect, and study thoroughly its habits in its different stages of growth. Unlike birds, quadrupeds and fishes, which have similar habits at all stages of growth, an insect, with its three separate stages of larva, pupa and adult, leads as it were three lives, with different surroundings, and in each of those stages may be regarded as a different animal. Then it is often extremely difficult to ascertain to what beetle or moth or bee such or such a grub or caterpillar belongs. Our entomologists are not numerous enough, and often from their time being taken up with the pursuits of their profession, usually not that of science, are unable to spend the time in the field to observe the

* Third Annual Report on the Injurious and Beneficial Insects of Massachusetts, being a reprint, with corrections, from the 20th Annual Report of the Secretary of the Massachusetts Board of Agriculture, 1873.

habits of insects for themselves. Unfortunately, also, so backward is the science of entomology in this country, that the attention of its students is at present fully engrossed with classifying and describing the adult insects. When it is to be borne in mind that there are within the limits of the United States, probably at a low estimate, ten thousand species of *Hymenoptera* (bees, wasps, ichneumon flies, saw-flies, etc.), half as many butterflies and moths, about ten thousand species of flies, as many of beetles (*Coleoptera*) and of bugs (*Hemiptera*), and several thousand species of grasshoppers, etc. (*Orthoptera*), and neuropterous insects, such as dragon-flies, caddis-flies, etc., etc., the whole amounting to upwards of fifty thousand species of insects, to say nothing of the spiders, mites and ticks, centipedes and millepedes, it is evident that in the mere preliminary work of identifying and properly describing these myriad forms—an intellectual work requiring as much good sense, discretion and knowledge as shown in the pursuit of medicine, the law or education,—that all this work, which is simply preliminary in its nature, is a vast one, and that the combined exertions of many minds over several generations will not exhaust the subject. As it is, there are in this country only about thirty entomologists who publish anything relating to insects. Necessary as it is, this work of classification is by no means the highest and most useful branch of physical science. He who studies carefully the habits and structure of one insect, and, if injurious to agriculture, lays before the farmer and gardener a true story of its mode of life, is a true benefactor to agriculture, and at the same time benefits science more than he who describes hundreds of new species. Such an one was Dr. Thaddeus W. Harris, whose leisure moments were consecrated to the benefit and advancement of the agricultural interests of our state, and the commonwealth perhaps never made a better investment than in supplying the agricultural community with an illustrated edition of his immortal work. On looking over Dr. Harris's work we find that he mentions about six hundred species as injurious to vegetation, and as others have been added since then, it is not improbable that we have at least one thousand destructive species, *i. e.*, about one-tenth of the entire number (10,000) of insects which undoubtedly are to be found living within the limits of this state. As to the losses sustained from their attacks it would be difficult to say how great they are, but it

is to be estimated at least by hundreds of thousands of dollars. The amount of waste by the agency of insects is really appalling, and even now but slightly appreciated by our farming community.

We have perhaps little idea how many insects are preying upon our crops, our shade and ornamental trees. There are, probably within the limits of our country, one-tenth of the number, *i. e.* five thousand, which are either at present engaged in the work of injury, or are destined to be, with the growth of civilization, which means in this instance the destruction of the natural food of these insects and the substitution of a different diet, our choicest grains and fruits, in their stead.

During the last summer the canker-worm was as destructive as ever, and it seems to have gained a firm foothold among us. It is scarcely creditable that so conspicuous and comparatively easily assailed an insect as this does so much annual damage. It would seem as if the birds did not feed upon it to much extent. We have personally never seen birds feeding upon the canker-worm, though Professor Wyman states that doves eat them sometimes in large numbers and it is thought that the crow blackbirds pick up the caterpillars. As we have stated in a former report there are certain kinds of caterpillars that birds do not relish. Indeed birds seem to have certain fancies of their own among edible insects. Thus the martin will store up in its nest quarts of the common striped beetle of the potato, to the exclusion of other insects.

The reporter would be greatly obliged for any facts upon this subject communicated by those who may have a chance to observe what birds feed on particular kinds of insects and at what season and month of the year.

Our cranberry crop has been grievously ravaged during the year past, though the writer has no information to give at present in relation to this subject farther than that recorded in the article entitled "New and Little Known Insects," in the "Report on Agriculture of the State for 1870," and that given in the author's "Guide to the Study of Insects," though he has visited several cranberry pastures during the recent autumn. In conclusion, before offering the accompanying remarks on certain injurious and beneficial insects, the reporter would invite the attention of agriculturists to those insects that prey on the cranberry crop and other injurious insects, and beg them to communicate to him at

Salem, specimens and information about their habits and extent of ravages which may be of use in making up the next year's report.

INSECTS INJURIOUS TO THE STRAWBERRY.

The May Beetle.—With the increasing attention paid to the culture of the strawberry, it has been found that several insects not before suspected to be inclined to feed on this plant, now habitually frequent it. Of these perhaps the most injurious is the strawberry saw-fly, which in this state, but more especially the western states, as in Illinois, does in some cases the most grievous damage. Then a few moths which have been known to feed on fruit-trees, the currant, etc., have transferred their affections to the strawberry; such are the apple-leaf-roller or *Tortrix*, the saffron measuring-moth (*Angerona crocataria*), and several other caterpillars found in the western states, and described in the entomological reports of Messrs. Walsh and Riley, and also in "Harris's Treatise on the Injurious Insects" of this state, and the reporter's "Guide to the Study of Insects."

Next however in importance to the strawberry saw-fly (*Emphytus maculatus*), is one of the most common and familar of all these insects which everywhere force their attention upon us. This is the common May beetle, June beetle or "dor bug," the American representative in its abundance and injurious qualities of the European cockchafer.

Dr. Harris has given a brief sketch of its habits and transformations in his "Treatise," and referred to the injury the grub, sometimes called "white-worm," does to the roots of grass, remarking that "in many places the turf may be turned up like a carpet in consequence of the destruction of the roots." He however does not say that it attacks the strawberry-roots, which it has for several years been known to do in gardens about Salem. My attention was especially called to its ravages by Mr. D. M. Balch, of Salem, who has lost many strawberry-plants by the white grub. It seemed evident that they were introduced in the manure placed around the roots, as during July and late in summer, a manure-heap near by swarmed with the well-known white grubs, in various stages of development, some apparently in the second year and others in the third year's growth. They eat the main roots of the plant, thus destroying one plant after an-

is to be estimated at least by hundreds of thousands of dollars. The amount of waste by the agency of insects is really appalling, and even now but slightly appreciated by our farming community.

We have perhaps little idea how many insects are preying upon our crops, our shade and ornamental trees. There are, probably within the limits of our country, one-tenth of the number, *i. e.* five thousand, which are either at present engaged in the work of injury, or are destined to be, with the growth of civilization, which means in this instance the destruction of the natural food of these insects and the substitution of a different diet, our choicest grains and fruits, in their stead.

During the last summer the canker-worm was as destructive as ever, and it seems to have gained a firm foothold among us. It is scarcely creditable that so conspicuous and comparatively easily assailed an insect as this does so much annual damage. It would seem as if the birds did not feed upon it to much extent. We have personally never seen birds feeding upon the canker-worm, though Professor Wyman states that doves eat them sometimes in large numbers and it is thought that the crow blackbirds pick up the caterpillars. As we have stated in a former report there are certain kinds of caterpillars that birds do not relish. Indeed birds seem to have certain fancies of their own among edible insects. Thus the martin will store up in its nest quarts of the common striped beetle of the potato, to the exclusion of other insects.

The reporter would be greatly obliged for any facts upon this subject communicated by those who may have a chance to observe what birds feed on particular kinds of insects and at what season and month of the year.

Our cranberry crop has been grievously ravaged during the year past, though the writer has no information to give at present in relation to this subject farther than that recorded in the article entitled "New and Little Known Insects," in the "Report on Agriculture of the State for 1870," and that given in the author's "Guide to the Study of Insects," though he has visited several cranberry pastures during the recent autumn. In conclusion, before offering the accompanying remarks on certain injurious and beneficial insects, the reporter would invite the attention of agriculturists to those insects that prey on the cranberry crop and other injurious insects, and beg them to communicate to him at

Salem, specimens and information about their habits and extent of ravages which may be of use in making up the next year's report.

INSECTS INJURIOUS TO THE STRAWBERRY.

The May Beetle.—With the increasing attention paid to the culture of the strawberry, it has been found that several insects not before suspected to be inclined to feed on this plant, now habitually frequent it. Of these perhaps the most injurious is the strawberry saw-fly, which in this state, but more especially the western states, as in Illinois, does in some cases the most grievous damage. Then a few moths which have been known to feed on fruit-trees, the currant, etc., have transferred their affections to the strawberry; such are the apple-leaf-roller or *Tortrix*, the saffron measuring-moth (*Angerona crocataria*), and several other caterpillars found in the western states, and described in the entomological reports of Messrs. Walsh and Riley, and also in "Harris's Treatise on the Injurious Insects" of this state, and the reporter's "Guide to the Study of Insects."

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other. From this it will be obvious that if we observe the plant to wilt and suddenly die, we may look for the white grub and at once kill it to prevent farther ravages. It is evident, so large and voracious are these worms, that one plant would be a mere trifle to one of them.

It also eats down in much the same manner young squash-plants, as I am told by Mr. C. A. Putnam, of Salem, who has been obliged to plant the seed over once or twice. They attack young plants at the time when they have thrown out three or four leaves. It is obvious that in dealing with this destructive insect we must become familiar with its habits. Every one knows the larva or grub of this insect, so that a detailed description is not necessary. It is a large, soft-bodied, thick, white worm, nearly as large as the thumb. Its head is yellowish or pale horn-colored. Its skin is so thin and transparent that the air-vessels and viscera can be seen through it, while, though it has three pairs of legs, it is so gross and unwieldy that it lies, when dug out of its retreat, flat upon its side.

How many years the grub lives before changing into the beetle we do not know, but probably at least three. It arrives at maturity in the autumn, and early in May in this state the chrysalis may be found in little rude cells or chambers about six inches under the mould, in which position we have found it in Maine late in May. During the latter part of May and early in June, *i. e.* for about a month, it flies about at night, especially on warm nights. By day it hides in fruit and other trees, clinging to the underside of the leaves by its long, curved claws, which are admirably adapted for the purpose. Here it does at times much injury, especially, as Harris remarks, to cherry-trees.

Where it lays its eggs is not definitely known, but it is probable that it burrows in the soil and there lays its eggs, as does the European cockchafer, of whose habits Harris gives a summary, and also the goldsmith beetle, of which we give an account farther on. Riley however says that "soon after pairing, the female beetle creeps into the earth, especially wherever the soil is loose and rough, and after depositing her eggs to the number of forty or fifty, dies. These hatch in the course of a month, and, the grubs growing slowly, do not attain full size till the early spring of the third year, when they construct an ovoid chamber, lined

with a gelatinous fluid; change into pupæ, and soon afterwards into beetles."

In the autumn at the approach of cold it descends to a considerable depth below the surface to avoid the frost, probably about two feet below the usual depth at which the ground is frozen in the winter. At the approach of warm weather, however, it makes its way up near the surface, where it forms a slight cell by wriggling about, and then passes into the pupa state. It is said to sometimes pupate and appear in the winged state in the autumn.

As to remedies against this grub, the careful gardener will in the first place destroy all those that he sees by crushing them to death. When the manure is spread over the strawberry bed he must watch it narrowly for the grubs so easily seen, and kill them. When a vine is seen to die down suddenly in summer he must then dig around the roots and search for them, and go over the bed carefully, even if help has to be employed. It is better to spend even much time and money for two or three years in succession, in endeavoring to exterminate these grubs, than to yield passively to the scourge. The remarks of Mr. Lockwood that we reprint in our account of the goldsmith beetle are eminently practical as applied to this insect. As for special remedies, we have none to propose. Watchfulness and care in culture are better than any special nostrums.

Undoubtedly the natural enemies of this grub are many, but we have no observations bearing on this point. A fungus attacks the grubs in certain seasons, often in considerable numbers. We have received specimens from Missouri of dead and dried grubs, with a long stem growing out from them, the result of the attacks of this fungus. It has been figured by Mr. Riley, who states that another fungus attacks this worm in Virginia. It is well known that caterpillars and even the common house-fly are sometimes attacked by a fungus which replaces the animal portion with its own vegetable substance.

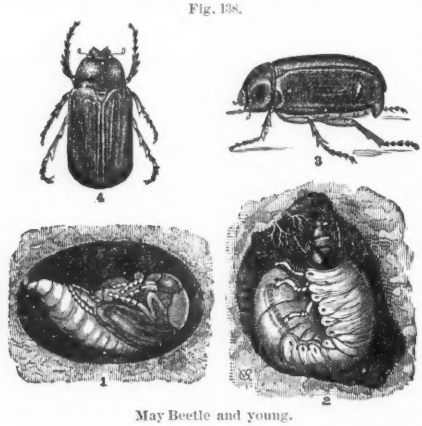
While many animals, such as skunks, moles, crows, etc., prey on the beetles, the only insect enemy I have personally observed is the fierce carnivorous Calosoma beetle (*C. calidum*) which I have noticed on a blueberry bush busily engaged in tearing open the hard, horny sides of one of these beetles, which was in vain

struggling to escape; on taking up the May beetle a large hole had been eaten into its side disclosing the viscera.

Occasionally the beetles appear in immense numbers. It is then the duty of the agriculturist to pick them off the trees and burn them. If the French take the pains to practise hand-picking, as in one instance "about eighty millions were collected and destroyed in a single portion of the lower Seine" (Riley), our gardeners can afford to take similar pains.

A description of the May beetle is scarcely necessary. The admirable figure, taken from Harris' work (fig. 138), gives a good idea of its appearance and size. It is bay colored, or chestnut and brown, with yellowish hairs beneath, and is nearly an inch in length. Its scientific name is *Lachnosterna fusca*, or, literally translated, the brown woolly-breasted beetle. The pupa is white.

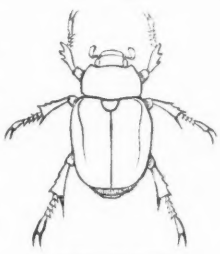
Fig. 138.



May Beetle and young.

The Goldsmith Beetle.—We also have in this state an insect allied to the preceding, and with much the same habits, both in the adult and preparatory states. It is the *Cotalpa lanigera* (fig. 139). It is nearly an inch in length, bright yellow above, with a golden metallic lustre on the head and thorax, while the under side of the body is copper-colored, and densely covered with white hairs.

Fig. 139.



Goldsmith Beetle.

Dr. Harris says that it is very common in this state, remarking that it begins to appear in Massachusetts about the middle of May, and continues generally till the twentieth of June. "In the morning and evening twilight

they come forth from their retreats, and fly about with a humming and rustling sound among the branches of trees, the tender leaves of which they devour. Pear trees are particularly subject to their attacks, but the elm, hickory, poplar, oak, and probably also other kinds of trees, are frequented and injured by them." Dr. Lockwood has found it on the white poplar of Europe, the sweet-gum, and has seen it eating the Lawton blackberry. He adds that the larvæ of these insects are not known; probably they live in the ground upon the roots of plants.

It has remained for the Rev. Dr. S. Lockwood to discover that the grub or larva of this pretty beetle in New Jersey devastates strawberry beds, the larva feeding upon the roots, in the same manner as the May beetle. His account was first published in the AMERICAN NATURALIST (vol. ii, pp. 186, 441). He says that in the month of May in the ordinary culture of his garden the spade has turned up this beetle generally in company with the May beetle. He found that some of the beetles, as in the case of the May beetle, assume the adult beetle state in October and remain underground for seven months before appearing in the spring.

Larva. The larvæ (fig. 140) he describes as "whitish grubs, about one inch and three-quarters long and over half an inch thick, with a yellowish-brown scale on the part corresponding to the thorax." I may add that it so nearly resembles the young of the May beetle that it requires a close examination to tell them apart. The proportions of the two are much the same; if anything the *Cotalpa* is slightly shorter and thicker, and its body is covered with short, stiff hair, especially at the end, while in the May beetle the hairs are much finer, sparse, and the skin is consequently shiny. They also differ in the head, being fuller, more rounded in *Cotalpa*, the clypeus shorter and very convex, while in the May beetle it is flattened. The upper lip (labrum) is in *Cotalpa* longer, more rounded in front and narrower at the base, and full convex on the surface, while in the young May beetle it is flat. The antennæ are longer and larger in the goldsmith beetle, the second joint a little over half as long as the third, while in the May beetle grub it is nearly three-quarters as long; the third joint is much longer than in the latter grub, while the fourth and fifth are of the same relative length as in the May beetle, but much thicker. The jaws (mandibles) are much alike in both, but not quite so acute in the *Cotalpa* as in the other, nor are the inner teeth so prominent. The maxilla is much longer and with stouter spines, and the palpi are longer and slenderer in the grub of *Cotalpa* than in the other, though the joints have the same relative proportion in each; the basal joint is nearly twice as long as in the May beetle. The under lip (labium) is throughout much longer, and the palpi, though two-jointed in each, are much longer and slenderer in the grub of *Cotalpa* than in that of the May beetle. The feet are much larger and more hairy in the *Cotalpa*. Both larvæ are about an inch and a half long, and a third (·35) of an inch thick at the widest part.

Fig. 140.

Larva of the Goldsmith Beetle.

As regards the number of years in the life of this insect, Dr.

Lockwood remarks that "when collecting the larvæ in May, I often observed in the same places grubs of the *Cotalpa* of at least four distinct ages, each representing a year in the life of the insect, judging from Renny's figures of the larvæ of the English cockchafer, or dor beetle (*Melolontha vulgaris*). But the cockchafer becomes an imago in January or February, and comes forth into active life in May, just four years from the deposit of the egg. Supposing our *Cotalpa* to take on the imago form in autumn, and to spend its life from that time to the next May in the ground, it would be five years old when it makes its début as an arboreal insect." It is possible that Dr. Lockwood may be in error regarding the age of this beetle, as M. T. Reiset says in France this insect is three years in arriving at its perfect beetle state. The following remarks on the habits of the European chafer may aid observers in this country in studying the habits of our native species. M. Reiset says (see "Cosmos" as translated in the AMERICAN NATURALIST," vol. ii, p. 209) "that this beetle in the spring of 1865 defoliated the oaks and other trees, while immense numbers of their larvæ in the succeeding year, 1866, devoured to a fearful extent the roots of garden vegetables, etc., at a loss to the department of the lower Seine of over five millions of dollars. This insect is three years in arriving at its perfect beetle state. The larvæ, hatched from eggs laid by the beetles which appeared in such numbers in 1865, passed a second winter, that of 1867, at a mean depth in the soil of forty one-hundredths of a metre, or nearly a foot and a half. The thermometer placed in the ground (which was covered with snow) at this mean depth, never rose to thirty-two degrees F. as *minimum*. Thus the larvæ survived after being perfectly frozen (probably most subterranean larvæ are thus frozen, and thaw out in the spring at the approach of warm weather). In June, 1867, the grubs having become full fed, made their way upwards to a mean distance of about thirteen inches below the surface, where, in less than two months, they all changed to the pupa state, and in October and November the perfect beetle appeared. The beetles, however, hibernate, remaining below the surface for a period of five or six months and appearing in April and May. The immature larvæ, warned by the approaching cold, began to migrate deep down in the soil in October, when the temperature of the earth was ten degrees above zero. As soon as the snow melted they gradually rose towards the surface."

As regards the time and mode of laying the eggs, we quote from Dr. Lockwood as follows: "On the evening of the 13th June last we caught in the drug-store, Keyport, whither they were attracted by the profusion of light, four *Cotalpas*, representing both sexes. These were taken home and well cared for. On the 16th a pair coupled. A jar of earth was at once provided, and the beetles placed on top of the dirt. In the evening the female burrowed and disappeared. Near midnight she had not returned to the surface; next morning she had reappeared. The earth was then very carefully taken from the jar, and, as removed, was inspected with a glass of wide field but low power. Fourteen eggs were found, not laid (as we expected) in one spot or group, but singly and at different depths. I was surprised at their great size. Laid lengthwise, end touching end, two eggs measured very nearly three-sixteenths of an inch. They were like white wax, semi-translucent; in form, long-ovoid and perfectly symmetrical. On the 13th of July one had hatched; the grub was well formed and very lively. Its dimensions were about five-sixteenths of an inch in length and about three-thirtieths of an inch in thickness. It was a dull white, the head-plate precisely that dull yellow seen in the adult grub, the legs the same color, and the extremity of the abdomen lead-color, the skin being transparent. For food, a sod of white clover (*Trifolium repens*) was given them, roots downward, knowing that the young larvæ would come upward to eat. They were then left undisturbed until August 19th, when the sod was removed, and it was found that the grubs had eaten into it, thus making little oval chambers, which were enlarged as the eating went on. They were carefully picked out and a fresh sod of grass and clover supplied. They had now grown five-eighths of an inch in length, preserving the same colors.

It is quite possible that a few of the eggs escaped me in the search. I am of opinion, however, that from fifteen to twenty is the average number laid by one beetle. In short, the insect lays her eggs in the night, probably not more than twenty. The hatching of these required in the present instance twenty-seven days. It must be remembered that a large portion of this time was remarkably cold and wet. It is almost certain that with favorable thermal conditions this might be lessened fully seven days.

Regarding its ravages in strawberry beds, I cannot do better than quote from Dr. Lockwood's excellent account in the AMERICAN NATURALIST: "When on a visit in September last to the farm of a celebrated strawberry grower in Monmouth county, N. J., my attention was directed to certain large patches badly thinned out by, as the phrase went, 'the worm.' The plants were dead on the surface and easily pulled up, the roots being eaten off below. It was observable that the fields which presented the worst appearance were all of the same kind of plant,—that known as Wilson's Albany Seedling. Besides this there were nine other varieties under culture,—Barnes' Mammoth, Schenck's Excelsior, the Agriculturist, Triomphe de Gand, Cutter's Seedling, the Jucunda, Pine-apple, Early Scarlet and Brooklyn Scarlet. While the Wilson stood second to none of these as a prolific fruit-bearer, yet it fell behind them in vigorous plant-growth. Hence, while every kind was more or less affected, the other varieties seemed saved by their own growth and energy from a destruction so thorough as was that of the Wilson. These patches were all planted in the spring, and all received the same treatment, the ground being kept open and free from weeds. The amount of the spring-planting was seven and a half acres. Of the Wilsons there were three different patches in places quite separated from each other, and on not less than five different kinds of soil. These patches were among and contiguous to those of the other varieties. While all suffered more or less, the chief injury befell the Wilsons, of which not less than two acres were irretrievably ruined. An examination turned up the depredator, who was none other than the larva of the goldsmith beetle, now engaged in the first one of its allotted three-summer campaigns of mischief. These grubs were from the eggs deposited in June in the well-tilled and clean soil, which, I have said elsewhere, I thought the *Cotalpa* preferred to meadow or grass lands. Compared with others, the larva of this beetle is sluggish and easily captured. The black grub of the spring, which is such a pest, attacking almost indiscriminately the early tender plants, inflicts its injuries chiefly in the night, the exception being that of dull and cloudy days. The night's mischief done, it descends into concealment at early dawn. Knowing this, the wise farmer is in search of it at an early hour, ere the warmth of the sun gives it warning to retreat. But the goldsmith grub can be taken at any hour of the day simply by scratching away

the earth from around the roots of those plants whose dark, shrivelled leaves tell of the enemy's presence. It is my belief that this devastation might have been spared by an outlay of from $20 to $30 for labor, much of which, under proper direction, could have been done by children. Therein would have been saved a strawberry crop for the ensuing summer, worth scarcely less than $2,500, for from this same farm the crop of a single acre has been sold for $1,500. Then, however valuable such labors are in the immediate results, that is but a fraction of their worth as respects the future. These *Cotalpa* grubs, with all their mischief, had not more than a third of their ultimate size; hence their real ravenousness is yet to come. Besides, what a prospect of increase of numbers, should even a moderate share of them reach maturity! Why should not our farmers seek to know something about their insect-enemies, and when practicable put forth some energy to meet such?"

Snails Injurious to the Strawberry.—Under this caption Prof. E. T. Cox publishes in the AMERICAN NATURALIST (vol. ii, p. 666) a note regarding the injury done in Indiana by a little snail (*Pupila fallax*), at present found occasionally though not abundantly in this state. Though this report refers chiefly to insects, yet in the future, as civilization advances and the country becomes more thickly settled, gardeners are undoubtedly destined to be plagued by these little animals, and a slight notice of them may not be out of place, as the ravages they commit may be sometimes wrongly attributed to insects.

It seems that Mr. and Mrs. Chappelsmith of New Harmony, Indiana, "found their strawberry plants dying rapidly, and on seeking for the cause discovered these mollusks at work upon the stems and crowns of the plants, rasping off the outer coating, and sucking their juices in such a manner as to cause them to decay. Mr. C. found as many as forty upon one plant, and thinks they have killed several thousand upon the different beds. Though more abundant on the strawberry, he has found them on a variety of plants. Since attention has been called to the depredations of these minute mollusks, they have been found at work upon the strawberry plants in all the gardens examined."

Though this species is not common with us, yet we have other kinds which are more or less so, and which may ultimately prove to be obnoxious. Yet it is not probable that snails will ever be

so abundant with us as in Europe, as our climate is much drier and hotter, snails needing a damp, rainy climate in order to flourish vigorously.

INSECTS INJURING THE BEAN.

The Bean-weevil.—In our article entitled "Injurious Insects New or Little Known," published in the Report of the Board of Agriculture for 1870, we described and figured the bean-weevil, which was then regarded as an imported species, the European *Bruchus granarius*, and some account was given of its habits. Afterwards in a short note published in our First Annual Report (p. 22), we stated that it was not an importation, but a native species which for some years has been known to be injuring the bean in New York and the Middle States. It was mentioned under the unpublished or manuscript name of *Bruchus varicornis* (Leconte). The same year Mr. Riley described it in his report on the injurious insects of Missouri under the name of *Bruchus fabæ*, and states that it appeared about ten years ago (1862) in Rhode Island, according to Mr. F. G. Sanborn, and is now known to appear in Illinois and Missouri.

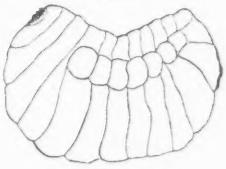
How extremely injurious this weevil has been, and still threatens to be, appears from both Mr. Riley's and my reports. We are sorry to add that this winter it is said to be very abundant in seed-stores in Boston, and unless checked in its course, a comparatively easy thing to do at this time, it will rapidly spread all over the state, and do incalculable injury to the bean crop.

I am indebted to Mr. C. A. Putnam, of Salem, for numerous living specimens of this weevil, with the beans from which they were emerging, obtained by him at a seed-store in Boston in February. We have figured, in our report for 1870, the bean perforated by the grubs. It is easy to tell by the little round dark spot on the outside of the bean, *i. e.*, the thin covering over the hole in which the weevil lies, whether the weevil lies within. Now is the time to plunge all the beans in hot boiling water to kill the weevils — treating them just as gardeners have been accustomed to deal with the well-known pea-weevil. Such beans as are found to be affected should at once be burned. Again, as suggested by Dr. Harris, in dealing with the pea-weevil, "if the peas are kept till they are a year old, the insects will leave them." So that by keeping the seed for two years in tin boxes, or other dry situa-

tions, where the weevil may come out and die, without being allowed to go at liberty, the beans may be sown with impunity. By the exercise of a little care, and by combination among gardeners this pest may be kept under.

Larva. The grub or larva occurred February 10th in different stages of growth, the largest being one-seventh (·14) of an inch long and about half as thick (·08). Other grubs were only half as long. Some chrysalides occurred also at this date while the adult beetles were coming out of the beans. The larva is a very thick, white, fleshy grub (fig. 141) with the body much curved and the head very minute and sunken in the body. The rings are much flattened, the sutures obscurely marked, and the rings are each divided by a transverse line separating it into two portions. There is a distinct, flattened, lateral ridge. The end of the body is much rounded and incurved. The head is white, becoming honey-yellow about the short, stout jaws.

Fig. 141.



Grub of Bean-weevil.

One specimen was in the semi-pupa state, being intermediate between the larva and pupa. Its body was straightened out, the head being at the extreme end and now quite prominent, while before it was hidden in the soft body. The three succeeding segments were full and swollen, the third being very distinct from the succeeding one, the basal abdominal segment. The whole body was much flatter and thinner than in the grub. It was evident that the remarkable changes by which it becomes transformed into the chrysalis state had begun.

INSECTS INJURIOUS TO FRUIT AND FOREST TREES.

The Seventeen-year Locust.—This remarkable insect having, after its long absence of seventeen years, again, as had been predicted by observers, made its appearance in the southerly parts of the state, we take this occasion to draw attention to its strange and unwonted habits, and to solicit aid from observers in the state in determining its natural boundaries. I should be greatly obliged if any persons in every town in the state in which it appeared would let me know of the fact, that we may ascertain its range. While it has been known to appear in the southeastern part of the state, and even as far east as Plymouth, situated on Massachusetts Bay, we want to know in what towns to the north of this it has appeared. The point is of much interest to naturalists, as in determining the northern boundary of the district it inhabits, which undoubtedly accords with certain lines of temperature which regulate the distribution of many other insects and plants, it may throw much light on the physical geography and meteorology of our state. The cicada also often does much injury to fruit-trees, especially in the West, and it is thus, aside from its deeply interesting and unique mode of life, an object of solicitude to farmers.

The most remarkable fact about this creature is that, while so far as we know, the other species of cicada pass but a year in attaining the winged state, the present one lives underground over sixteen, assuming at the end of seventeen years the perfect winged state. We have seen that the May beetle is about three years in obtaining the beetle state, and the wire-worms and boring-beetle, such as the apple-borer, may be four or five years in the larval condition, but no other insects are as yet known, with this sole remarkable exception, to be so long-lived in their immature state.

The remarks that we have to make are simply supplementary to what the reader may find in Dr. Harris' admirable account in his "Treatise." He brings out the important fact that these insects are said, in the larval state, to do much injury to apple and pear trees by drawing the sap from the roots, so that the tree may decline in health for years without any apparent cause. This needs to be substantiated by farther observation. As regards the kinds of this I may quote from a communication from William Kite in the AMERICAN NATURALIST, vol. ii, p. 442, as confirming and adding somewhat to Dr. Harris' statements: "Seeing in the July number of the NATURALIST a request for twigs of *oak* which had been stung by the so-called seventeen-year locust, I take the liberty of sending you twigs from *eleven* different varieties of trees in which the females have deposited their eggs. I do this to show that the insect seems indifferent to the *kind* of wood made use of as a depository of her eggs. These were gathered July 1st, in about an hour's time, on the south hills of the 'Great Chester Valley,' Chester county, Pa. No doubt the number of trees and bushes might be much increased. The female, in depositing her eggs, seems to prefer well-matured wood, rejecting the growing branch of this year, and using the last year's wood and frequently that of the year before, as some of the twigs enclosed will show. An orchard which I visited was so badly 'stung' that the apple trees will be seriously injured, and the peach trees will hardly survive their treatment. Instinct did not seem to caution the animal against using improper depositories, as I found many cherry trees had been used by them, the gum exuding from the wounds, in that case sealing the eggs in beyond escape.

"The males have begun to die, and are found in numbers under the trees; the females are yet busy with their peculiar office. The length of wood perforated on each branch varied from one to two

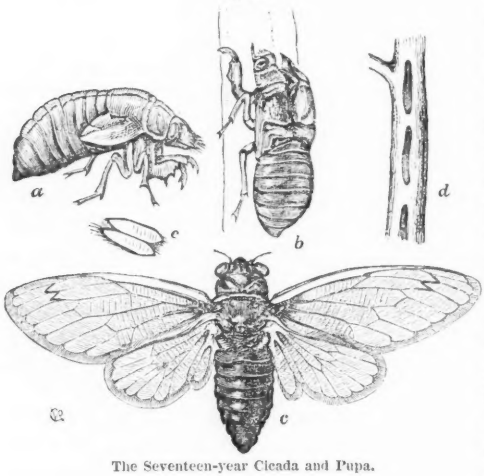
and a half feet averaging probably eighteen inches; these seemed to be the work of one insect on each twig, showing a wonderful fecundity.

"The recurrence of three 'locust-years' is well remembered in this locality—1834, 1857 and 1868. There has been no variation from the usual time, establishing the regularity of their periodical appearance."

As regards the time and mode of hatching, Mr. S. S. Rathvon of Lancaster, Pa., contributes to the same journal some new and valuable facts, which we quote: "With reference to the eggs and young of the seventeen-year cicada, your correspondent from Haverford College, Philadelphia, is not the only one who has failed to produce the young by keeping branches containing eggs in their studios. I so failed in 1834 and 1851, and indeed I have never heard that any one has succeeded in that way, who has kept them for any great length of time. In the brood of 1868, the first cicadas appeared here in a body, on the evening of the second day of June. The first pair *incoitu*, I observed on the 21st, and the first female depositing on the 26th of the same month. The first young were excluded on the 5th of August. All these dates are some ten days later than corresponding observations made by myself and others in former years. On the 15th of July I cut off some apple, pear and chestnut twigs containing eggs, and stuck the ends into a bottle containing water, and set it in a broad, shallow dish also filled with water, the whole remaining out of doors exposed to the weather, whatever it might be. The young continued to drop out on the water in the dish for a full week, after the date above mentioned. I could breed no cicadas from branches that were dead and on which the leaves were withered, nor from those that from any cause had fallen to the ground, and this was also the case with Mr. Vincent Bernard, of Kennet Square, Chester county, Pa. After the precise time was known, fresh branches were obtained, and then the young cicadas were seen coming forth in great numbers, by half a dozen observers in this county. As the fruitful eggs were at least a third larger than they were when first deposited, I infer that they require the moisture contained in living wood to preserve their vitality. When the proper time arrives and the proper conditions are preserved, they are easily bred, and indeed I have seen them evolve on the palm of my hand. The eyes of the young cicadas are seen through the egg-skin before it is broken."

Mr. Riley, in an interesting account of this cicada in his "First Annual Report on Noxious, Beneficial, and other Insects of Missouri" for 1869, has shown that in the southern states thirteen-year broods of this insect are found. He remarks: "It was my good fortune to observe that besides the seventeen-year broods, the appearance of one of which was recorded as long ago as 1633, there are also thirteen-year broods, and that, though both sometimes occur in the same states, yet in general terms, the seventeen-year broods may be said to belong to the northern and the thirteen-year broods to the southern states, the dividing line being about latitude thirty-eight degrees, though in some places the seventeen-year brood extends below this line, while in Illinois the thirteen-year brood runs up considerably beyond it. It was also exceedingly gratifying to find, four months after I had published this fact, that the same discovery had been made years before by Dr. Smith, though it had never been given to the world."

Fig. 142.



The Seventeen-year Cicada and Pupa.

Mr. Riley predicts that in southern New England a brood will appear in 1877 and 1885. Probably the Plymouth brood which appeared in 1872, will not appear again for seventeen years, namely, in 1889, the two broods noticed by Riley appearing west of this town. As regards its appearance in Plymouth, in this state, Harris states that it appeared there in 1633. The next date given is 1804, "but, if the exact period of seventeen years had been observed, they should have returned in 1803."

Mr. B. M. Watson informs me from his personal observation,

that it also appeared in 1838, 1855 and 1872. In Sandwich it appeared in 1787, 1804 and 1821. In Fall River it appeared in 1834; in Hadley in 1818; in Bristol county in 1784, so that as remarked by Harris and others it appears at different years in places not far from each other. So that while in Plymouth and Sandwich we may look for its reappearance in 1889, in Fall River it will come in 1885, or four years earlier.

There are three species of cicada in this state, and in order that they may not be confounded in studying the times of appearance of the different broods of the seventeen-year species I add a short description of each form, so that they may be readily recognized in the winged and immature states.

Fig. 143.

Larva of Seventeen-year Cicada.

The two largest species are the seventeen-year locust (*Cicada septendecim*) and the dog-day cicada (*C. pruinosa*). Fig. 142, copied from Riley's report gives a good idea of this species: *a* represents the pupa; *b* the same after the adult has escaped through the rent in the back; *c* the winged fly; *d* the holes in which the eggs *e* are inserted. Fig. 143 represents the larva as soon as hatched. The adult may be known by its rather narrow head, the black body and bright red veins of the wings. The wings expand from two and a half to three and a quarter inches.

The pupa is long and narrow, and compared with that of *C. pruinosa* the head is longer and narrower, the antennæ considerably longer, the separate joints being longer than those of the dog-day locust. The anterior thighs (femora) are very large and swollen, smaller than in *C. pruinosa*, though not quite so thick, with the basal spine shorter than in that species, while the snag or supplementary tooth is larger and nearer the end; the next spine, the basal one of the series of five, is three times as large as the next one, while in *C. pruinosa* it is of the same size, or if anything smaller. The toe-joint (tarsus) projects over two-thirds of its length beyond the end of the shank (tibia), while in the other species it only projects half its length. The terminal segment of the body is rather larger than in *C. pruinosa*. The body is shining gum-color or honey-yellow, with the hinder edge of the abdominal segments thickened, but no darker than the rest of the body. Length one inch (·90–1), width about a third of an inch (·35) being rather smaller than that of *C. pruinosa* and much larger than that of *C. rimosa*.

The dog-day harvest-fly may at once be known by its large head, as wide as the body, and by the green markings on the head and thorax, especially the W-shaped mark on the latter. It expands three inches, and is a larger and more bulky insect than

the preceding. We know but little of its habits. Harris says that it invariably appears with the beginning of the dog-days, and in the vicinity of Boston he has heard it for many years in succession, with only one or two exceptions, on the 25th of July, for the first time in the season. According to Prof. A. E. Verrill, in our "Guide to the Study of Insects," it lays its eggs in the stems of the solidago or golden rod. "It made a longitudinal incision with ragged edges into the pith of the plant, then with its ovipositor forced its eggs a little distance down into the pith below the external opening: there were two rows of eggs succeeding the first single one, each pair diverging outwards, the lower ends of each pair nearly touching each other, and all placed very near together."

Fig. 144.

Pupa of Cicada pruinosa.

The pupa (fig. 144) is much the largest and thickest of the three species, being nearly twice as bulky as that of the two others. The head is very broad, short, triangular, much shorter than in the seventeen-year locust. There are no dark bands crossing the body. It is an inch in length and nearly one-half (·45) an inch wide.

One smaller species, the least cicada (*C. rimosa*), expands a little less than two and a half inches, and has a narrow head, with bright red markings on the head and thorax. For several years in Brunswick, Maine, I have noticed that it began its song on the 10th of June, and in this state it probably sings by the 1st of that month.

Its pupa (fig. 145) is in most respects intermediate between the first two species. The head is broadly triangular, like that of *C. pruinosa*. The antennæ have shorter and smaller basal joints, and not much larger than the second, while they are very unequal in size in the two other species; the third joint is much shorter than that of *C. septendecim*. The front of the head is much more hairy than in the others. The thorax is shaped much as in *C. pruinosa*, but the insect differs from both species in having a broad, dark brown conspicuous band on the hinder edge of each thoracic and abdominal ring.

Fig. 145.

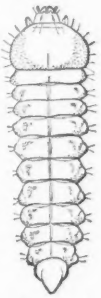
Pupa of Cicada rimosa.

The anterior femora are rather shorter than in the other species, but on the whole more like those of the seventeen-year cicada than the *C. pruinosa*. The spines are large and heavy; the basal one like that of *C. pruinosa*, but rather shorter and broader, with the tooth situated nearer the base. Of the five inner teeth the first one is twice as large as the second. Near the end of the tibiæ are two well-marked teeth, much more distinctly marked than in the other two species, which have but one low appressed tooth in their place. The tarsus projects about a third of its length beyond the tip of the tibia. Length ·80, breadth ·35 inch.

The Brachys Leaf-miner.— This and the following beetle have the singular habit of mining the leaves of plants. It is rarely that beetles live this sort of life, though many caterpillars and

maggots of flies are leaf-miners. Dr. Harris has given in his "Treatise" an account of the larva of Hispa which mines the leaf of the apple tree, eating the pulpy substance between the upper and under surface of the leaf. The two insects of which we now treat belong to the family of Buprestids, several species of which do much injury to our fruit and shade trees in the grub state. They are footless grubs and recognized by the broad, rounded, flattened segment just behind and partially enclosing the head. The young of the following insects depart somewhat from this typical form owing to their peculiar leaf-mining habits. The first of these is the young of the *Brachys æruginosa* which has been found by V. T. Chambers, Esq., of Covington, Ky., mining the leaves of the beech tree, and I am indebted to him for a specimen of the larva here figured (Fig. 146).

Fig. 146.



Larva of Brachys.

I may remark here that a closely allied beetle (*B. terminans*), I have often found resting in the leaves of the oak and beech. The beetles of this genus are flattened, angular ovate, and less than a quarter of an inch in length, and the scutellum is small, as Leconte observes, while the shanks (tibiæ) are linear. In the succeeding genus, Metonius, Leconte says that the body is triangular, while the scutellum is large, and the shanks are dilated.

Larva. The body of the larva is rather long, with the segments very deeply cut, being flattened, and produced laterally into a triangular projection, giving a serrate outline to the body, the teeth being obtusely rounded. The segment next behind the head is the widest, the succeeding segments gradually decreasing in width and increasing slightly in length to the end. The terminal segment is about half as wide as the body in its widest portion, and is somewhat triangular, with the sides parallel, and the tip obtusely pointed. The prothoracic segment or the one next the head is broader than long, and has a fleshy projection on each side at the base of the head. On the upper side of this segment is a large, square, slightly horny area. The head is anteriorly pale honey yellow, with two dark longitudinal parallel lines; the horny portion is about as long as broad, much flattened, subtriangular. The antennæ are very minute, slender, three-jointed, with the joints nearly equal in length. The jaws and palpi are so minute that a description will be of no practical use here. The body is finely shagreened, with a few fine scattered hairs. It is whitish, with a slight greenish tinge, and a quarter (·25) of an inch long, and less than a tenth (·07) of an inch broad. It was sent to me alive in September.

The Tick Trefoil Leaf-miner.—This insect (*Metonius lævigatus*) which is not uncommon in this state, has been found by Mr. V. T. Chambers of Covington, Ky., mining the leaves of the tick trefoil (*Desmodium*) during the early part of September. The larva is from ·15 to ·20 inch in length, and mines a broad, irregular patch,

sometimes only half the length of the leaf, but often it extends its burrow around the end of the midrib, half way down the other side of the leaf. The track of its burrow is irregularly sinuous. At the end of this gallery or burrow it forms a round chamber just as wide as the body is long, disk-shaped, the walls being convex, the cell looking like a smooth, regular blister.

Fig. 147.

Larva of Metonius.

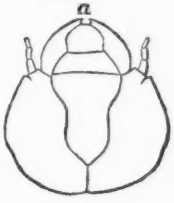
Larva. The grub (fig. 147) differs greatly in form from the preceding one, the body being quite thick, but little flattened, being rather convex above and below; in form oval lanceolate, widest in the middle, tapering much more rapidly posteriorly than toward the head. The segments, especially those of the abdomen, very convex on the sides, being produced triangularly into very acute teeth. The prothoracic ring is about the same width as the fifth abdominal ring, being narrower than the mesothoracic ring and having the sides somewhat sharply pointed, while those of the succeeding (metothoracic) segments are rounded. The eighth abdominal segment, or one next to the last, is transversely oblong, and about two-thirds as wide as the seventh. The ninth and last is a little over one-half as wide as the eighth. It gives rise to a minute projection at the end. The prothoracic segment and head are closely soldered together; the two together are transversely ovate elliptical, full convex on the front edge, the separation between the head and succeeding ring being indicated by a slight notch. The anterior surface of the head is somewhat flattened, with a small, squarish, pale, horny area. The horny portion of the front of the head is very minute compared with the similar part in the Brachys larva, and is scarcely perceptible except under high magnifying powers. The body is uniformly pale greenish, and the skin is smooth. The differences between the two larvæ are most remarkable, when we consider how closely the beetles resemble each other.

The Spotted-necked Languria.—This beetle is allied to Trogosita, an insect which is known to be injurious to housed grain, though the grub is still more intimately related to the European *Nemosoma elongatum*, which is found under the bark of elms in burrows inhabited by Hylesinus, a wood-boring beetle. Having received the Languria in all its stages of growth, from Mr. Belfrage of Texas, though the insect occurs in the middle states, it is thought that a description of it will not be out of place in a report on economic entomology, as some members of the group to which it belongs are known to be destructive. The adult beetle was first described by Say (under the name of *Languria puncticollis*) from Ohio. It is pale reddish, with the fore legs, wing-covers and end of the body black, with a large distinct black spot in the middle of the neck (prothorax). It is said by Mr. Say to frequent flowers.

The larva (fig. 148) is unusually long and slender, cylindrical, the body being of uniform thickness throughout, whitish, with smooth segments. The head is but little narrower than the rest of the body; the eighth ring of the abdomen is as large as the rest, while the ninth is much smaller, being rounded and bearing two dorsal, upcurved,

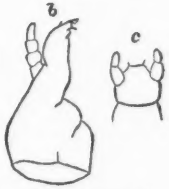
acute hooks. There are a few scattered hairs over the body. The six thoracic legs are well developed, and there is a stout, short, anal prop-leg. As usual there are nine breathing-holes (stigmata) on each side of the body. The head is somewhat flattened, squarish, the postclypeus (as we may call the triangular inclosure in the top of the head), shield-shaped with apex acute, and with two shallow pits (eyes?) on each side of the middle. The true clypeus is short, transverse. The feelers (antennæ) are inserted on the side of the head, and are as long as the clypeus is broad; they are four-jointed, with the third longest, the fourth very slender, not quite so long as the second. Upper lip (labrum) transversely oval, elliptic, the front edge curved, and the surface moderately convex. The jaws (mandibles) are stout, black at tips, three toothed, the upper tooth small, the two lower ones equal. The maxillæ (*b*) have four-jointed palpi reaching to the end of the closed mandibles; the joints of nearly equal length; the third slender, but scarcely longer than the basal joint. The labium (lower or under lip, *c*) is small and situated on a long, narrow mentum; the palpi are two-jointed, the joints subequal, the second but a little longer than the first. Length of body, ·65; thickness, one-tenth of an inch (50 specimens). The pupa (fig. 149) is white, long and slender, with the club-shaped antennæ reaching to the middle of the anterior tarsi; the tarsi of the middle pair of legs reaching to the hinder edge of the first abdominal segment; hinder pair of legs concealed, with the exception of the femora-tibial joint, by the wing-covers, the latter being long, pointed and ribbed; they reach to the end of the fourth abdominal segment. Near the hind edge of each segment is a dorsal ridge, bearing stiff hairs, and from three to seven unequal sharp spines, which on the sixth segment are arranged in two irregular rows, with six larger than the rest, and tipped with black. On the terminal segment are two large, equal, erect, long and slender blackish spines, and a pair of ventral, sharp tubercles on the seventh segment.

Fig. 149 *a*.



Figs. 148 and 149.

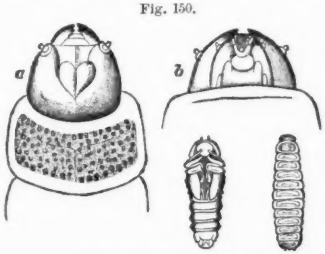
Larva and pupa of Languria.



Head of larva of Languria.

The body is naked, whitish, with a few scattered hairs along the sides. The head cannot be seen from above, being covered by the prothorax; it is rounded oval, and free from the prothorax beneath, with a few short scattered hairs. It is about half (·50–·60) of an inch long. (Thirty specimens.)

Fig. 150.



Larva and pupa of Dacne.

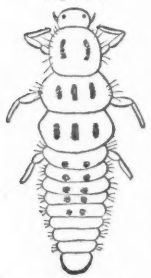
Of probably somewhat similar habits is the *Dacne heros* (fig. 150, larva and pupa; *a*, upper, *b*, under side of head), the early stages of which have been communicated to me by Dr. H. Shimer, of Illinois. The grub of an allied species (*D. fasciata*) found in this state, is said

by Candèze to live about New Orleans in the diseased trunks of the palmetto. It is not known what tree it inhabits in this state.

BENEFICIAL INSECTS.

The Aphis-eating Lady-beetle.— Among the insects which do incalculable benefit to agriculture, are several kinds which prey almost exclusively upon the Aphis or plant-louse. The Syrphus flies in the maggot state devour great quantities, and so do the larvæ of the lace-winged fly (Chrysopa). Scarcely less valuable aids to the gardener are the young of the "Lady-bird" beetle (Coccinella). During the past summer we have traced the transformations of a species (*Psyllobora* 20-*maculata* Say) which lived in all its stages on the leaves of the horse-chestnut during the month of August. As no aphides were seen on the leaves, I am inclined to think that in this instance the food of the young lady-bird was certain freshly hatched Psoci (Coecilius), aphis-like neuropterous insects which were running about over the leaves, masses of their eggs being attached to the leaves, and as usual covered with a thin web. Indeed some Coccinellæ feed on the eggs and young of their own kind. This lady-bird is a very small beetle, a tenth of an inch long; pale, whitish yellow, including the legs and antennæ. There are four black spots on the prothorax, and nine on each wing-cover, two on each wing cover usually running together, thus making twenty distinct spots in all.

Fig. 151.



Larva of "Lady-bird."

The Larva (fig. 151) is long and slender, with a rather small head, which is a little over half as wide as the segment (prothorax) next to it; it is somewhat trapezoidal in form, being widest in front, a little longer than broad, with black, conspicuous eyes consisting of four or five raised facets. The stout, minute antennæ are two-jointed, the joints being of equal thickness, the second a little shorter than the first. The upper lip (labrum) is small, transversely broad ovate, with the front edge rounded. The jaws are quite small. The maxillæ are very large, obtuse cylindrical, projecting far beyond the head. The labium is small and short.

The body is widest on the third segment behind the head, and shorter than the first segment, the three segments gradually decreasing in length; while the abdominal segments are nearly equal in length, and very convex laterally. The form of the terminal (ninth) segment I could not make out, as all my specimens were preparing to affix themselves to the surface of the leaf, and this segment was greatly enlarged and elongated, ending in a soft and membranous ruffle-like dilatation by which the insect was evidently about to gum itself to the leaf.

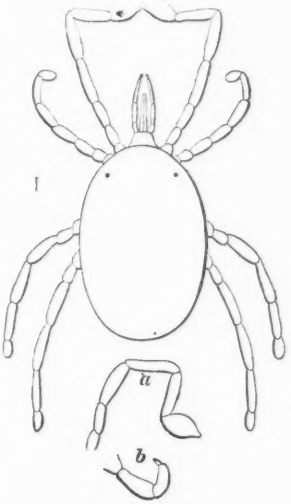
The body is covered with short, stiff hairs. It is white, with two dark spots on the segment next the head, four on each of the two following segments, and two on the five

succeeding segments; these spots are thickened portions of the skin, giving rise to hairs. The legs are stout, the toe-joint ending in a single claw, with four or five tenent hairs at the end of the joint. Length about a seventh (·15) of an inch.

The pupa is of the usual form in the group, but is white, with two faint dorsal dark spots on the middle thoracic segment, and two on the basal segment of the abdomen; farther behind is a pair of large, converging, black spots beginning on the second abdominal segment, and ending on the fourth; while on each side of the fourth are two dark spots. There are two slight dorsal spots on the fifth segment. The body is usually provided with a few fine, scattered hairs, but in a very small specimen (·06 inch long) the upper side is densely covered with long, thick hairs, the body being naked beneath. The larger specimen measured ·12 inch in length.

The Aphis-eating Mite.—Quite an unsuspected enemy of the aphis is a little garden-mite, which I found in July and August last in considerable numbers in my garden, busily engaged in devouring the plant-lice on the rose-bushes.

Fig. 152.



Aphis-eating Mite.

We know but little of the numerous kinds of mites which abound in this country, and but few species are known to prey on other insects. The present species is allied to the red garden-mite (*Trombidium*), which is often seen running over flower beds. It is the six-legged young of these mites which, under the name of harvest-mites, are so irritating and annoying when they get upon our bodies, as they work their way in under the skin. Their natural hosts are various insects, such as grasshoppers, etc., as we often perceive them with their heads stuck in between the joints of the latter. They are all vermilion-red in color, and in former times have been used as a dye.

Our species is apparently a *Trombidium*, or closely allied genus, and perhaps the specimen we figure here is immature. It may be called *Trombidium? bulbipes* (fig. 152, *a*, leg; *b*, palpus, side view) in allusion to the swollen, bulb-like terminal joints of the legs. It is scarlet red, regularly ovate in form, with a distinct, squarish head separate from the body, and two deep-red eye-spots situated over the insertion of the second pair of legs. The beak is long, slender, sharply conical, and reaches to near the middle of the third joint of the palpi; the latter four-jointed, the second and third joints of nearly equal size, the fourth very minute; when extended the palpi reach nearly to the end of the third joint of the first pair of legs. The fore feet are much

larger, thicker, and rather longer than the fourth pair, and inserted very near the head; the terminal joint is much swollen, ovate, the preceding joint being slenderer than the others. The second pair are about half as long as the first pair. It is deep scarlet-red, and the body and limbs are densely covered with short, stout hairs.

This species, though quite different in the form of the body, yet in the proportions and form of the legs and mouth-parts is congeneric with the European *Trombidium papillosum* of Hermann, which is said to live on the trunks of trees and in moss.

THE RELATION BETWEEN THE COLOR AND THE GEOGRAPHICAL DISTRIBUTION OF BIRDS.

BY ROBERT RIDGWAY.

THE July number of the NATURALIST contains a criticism of my paper on the relation between color and geographical distribution of birds* which is doubtless by this time familiar to the readers of this journal. The tone of this criticism renders it necessary for me to reply to it; but in doing so I shall endeavor to use as little space as possible, and limit my defence to the statement of a few simple truths, which I hope will answer the purpose as well as a lengthy discussion.

The specific charges made against me are two in number: (1) I am accused of "appropriating Mr. Allen's work without acknowledgment" to the latter author; and (2) of dishonestly claiming originality in the conception of certain laws and of cases illustrating them. These charges are preferred severally in the following words: — "he writes as if his views were both novel and original, which is not the case. To speak plainly, the paper is based entirely upon Mr. Allen's views, without the slightest allusion to this author; and is illustrated chiefly by cases already published, yet without proper references."

As regards Mr. Allen's work, I am not only willing, but desirous, that he should receive all the credit due him for his well accomplished task of elucidating the laws of climatic color-

* On the relation between Color and Geographical Distribution in Birds, as exhibited in Melanism and Hyperchromism. Am. Journ. Sci. iv, Dec., 1872, p. 454; v, Jan., 1873. p. 39.

variation, and geographical distribution. This gentleman's writings place him in the foremost rank of the philosophical ornithologists of the present day; their high merit and great importance being recognized by all to whom they are familiar. I have the highest respect for Mr. Allen's works; they show careful study, deep thought, persevering search for facts, and thorough, analytical mode of treatment. About their only fault consists in the two frequent evidence of conclusions "jumped at," or based upon insufficient evidence.

But as justly as Mr. Allen deserves his high position among the most thorough and advanced ornithologists of the day, we must not lose sight of the fact that he is not the only one who has written upon the subject of climatic color-variation and geographical distribution. Professor Baird, the pioneer in this subject, so far as America is concerned, first made known the main governing laws; and thus opened the way to later researches. But even he is preceded by Dr. Gloger who anticipates *all* American writers in many generalizations of this kind, published as long ago as 1833.*

A few of Dr. Gloger's generalizations, which bear more directly upon the province of this paper, are the following:

"The variation in color of birds from one country to those from another, is influenced not only by the mean temperature of the year, but also by that of single months (those about the time of the most rapid growth or molt) *and by the relative time and quantity of the falling snow and rain*" (p. 10. See pp. 239-241 of Mr. Allen's paper). "Light also has influence"—in the change of color (p. 110). "Heat has influence by drying out the moisture, whereby the action producing a change is a mechanical one" (p. 71). "The fact that in some summers there are more cuckoos of a reddish brown color, or with reddish brown spots, may probably be owing to the general or periodical atmospheric constitution of the year in question" (p. 98).

In 1866, before the appearance of any of Mr. Allen's writings, Professor Baird published a paper entitled "The Distribution and Migrations of North American Birds,"† in which much was said regarding climatic variations in color and proportions. The generalizations advanced in this paper are the following:

* Das Abändern der Vögel dursch Einflufs des klimas. By Dr. Constantin Lambert Gloger, Breslaw, 1833.

†American Journal of Science and Arts, Vol. xli, Jan. and March, 1866.

1. *Latitudinal and altitudinal variation in size* of resident species; northern bred individuals, and those born at high elevation, being larger than those born farther south or in the low lands.

2. *Absolute increase of the size of the bill, even with diminution in general bulk*, in Florida birds, as compared with individuals of the same species born north of that peninsula: the same rule applying, to a less extent, to birds from Cape St. Lucas.

3. *Longer tails of western birds than of eastern examples of the same species.*

4. Darker color of birds from the Pacific coast than of specimens of the same species from the interior, "the latter frequently exhibiting a bleached or weatherbeaten appearance, possibly the result of greater exposure to the elements, and less protection by dense forests."

Here then are three laws of climatic or regional variation in size and proportions, and two of color, in which Mr. Allen is anticipated by Professor Baird. But without going farther into the literature of the subject, I will proceed at once to discuss Mr. Allen's celebrated work published in 1871,* in order to show wherein he has anticipated me in the announcement of generalizations, in cases illustrating them, or in reducing specific names to the rank of race, or "variety," names. On p. 235, the law of increased intensity of color to the southward is announced, this not having been especially noted by previous writers (though Gloger says something indefinite in relation to it in his work above cited). This law, then, originates with Mr. Allen. The cases which he cites in illustration are the following: *Quiscalus purpureus*, *Agelaius phœniceus*, *Ortyx Virginianus*, *Sturnella "Ludoviciana"* (= *magna*), *Galeoscoptes Carolinensis*, *Harporhynchus rufus*, *Centurus Carolinus*, *Picus pubescens*, *P. Gairdneri*, *Colaptes auratus*, *Thryothorus Ludovicianus*, *Troglodytes ædon*, *Geothlypis trichas*, *Pipilo erythropthalmus*, *Buteo lineatus* and *Bucephala Americana*(?). The idea of "the so-called *Bucephala Islandica* being the larger northern type of *B. Americana*, in which the white markings on the head and wings occupy a somewhat larger area," is entirely erroneous, as every one acquainted with these very different species

*Bulletin Mus. Comp. Zoöl., Cambridge, Mass., ii, 1871. Part III. On Individual and Geographical Variation among birds, considered in respect to its bearing upon the Value of certain assumed Specific Characters, pp. 186–250.

will admit. The other cases cited show only slight (sometimes inappreciable) manifestations of this law within the territory of the United States. Thus none of my cases were "already published," and, besides, all were in a new geographical field.

The laws of variation with longitude, which Mr. Allen lays down, are the following:

1. *Brighter colors of the birds from the interior, than of those from the Atlantic States;* with a tendency to more ferruginous tints in some species and to melanism in others.

2. *Brighter or darker colors of the birds from the Pacific coast (especially north of the 40th parallel) than of those from the interior.*

3. *Lighter colors of birds from the arid, sterile plains than of those from either the eastward or the westward.*

By referring to this paper, it will be seen that all the above laws are substantially the same as in the generalizations made by Professor Baird in 1866, so that they were at the time of the publication already "the common property of ornithologists;" while the proposition that red areas "spread," or enlarge their field in proportion as we trace certain species toward the Pacific coast, and that in the same proportion yellow often intensifies in tint, is a law of which Mr. Allen makes no mention, and which is, so far as he is concerned, original with me; at the same time I claim originality for the cases illustrating both this and the foregoing laws, though I have never thought before of claiming either the generalizations or the examples as discoveries of my own.

Having given my defence as far as Mr. Allen is concerned, I shall now attend to the cases in which I reduced previously recognized "species" to the rank of geographical races, or "varieties," "the implication being, that such nomenclature, and the views sustaining it, are novel." Dr. Coues professes to have anticipated me in several of these cases by using the same nomenclature in his "Key," and other previous works. How far he is justified in this it is my purpose to show.

The case of *Chrysomitris*, Dr. Coues claims to have "first worked out, in 1866 (Proc. Phila. Acad., 81), exactly as it is here presented, although *C. psaltria* was not there formally brought into this connection, as it has since been by us (Key, Oct., 1872, 132, 133)." How much Dr. Coues is entitled to make this assertion

may be judged from the following summary of his views, as expressed in the first work to which he calls attention :—

138.* CHRYSOMITRIS (PSEUDOMITRIS) *psaltria* (Say) Bonap.
139. CHRYSOMITRIS (PSEUDOMITRIS) MEXICANUS (Swains.) Bonap.
[A. Var. *mexicanus* Swains.]
[B. Var. *columbianus* Lafr.]
[C. Var. *arizonæ* Coues.]

Dr. Coues' reasons for keeping *psaltria* apart from *Mexicanus* and its varieties are explained by his own words, which we quote from p. 83 of the first paper cited :— . . . . "the typical *psaltria* is so very diverse from *mexicanus* proper, and the doubtful specimens" (meaning var. *Arizonæ*) "incline so very decidedly toward the latter, that, in the impossibility of uniting *psaltria* with *mexicanus*" (!!!) "we must consider them" (the doubtful specimens —var. *Arizonæ*) "as varieties of the latter, unless, indeed, they be hybrids between the two." Thus it is very plain that *C. psaltria* was not then formally brought into the connection in which I placed it. My arrangement of these forms was as follows :

CHRYSOMITRIS PSALTRIA, Say.

a. Var. *psaltria* Say. Rocky Mts. of the U. S.
b. Var. *arizonæ* Coues. U. S. and Mexican boundary.
c. Var. *mexicana* Swains. Mexico and Central America.
d. Var. *columbiana* Lafr. Isthmus of Panama and adjacent localities.

In discussing the relationship of these forms to one another, Dr. Coues does not even note the progressive increase of black from *psaltria* to *Columbiana*—much less does he appear to consider the manifestation of any climatic law affecting color as applicable in this case—but merely gives the comparative characters of the several races, and remarks, incidentally, that there is a gradual transition between the two extremes (*Columbiana* and *Arizonæ*—*psaltria* being positively separated from the series, as a distinct species, in the manner shown above). As regards "bringing it into the connection" of a race along with *mexicanus* in the "Key," Dr. Coues may, perhaps, remember the occasion upon which I explained the case to him, illustrated it by a series of specimens, and discussed the matter with him without hesitation.

In the treatment of the races of *Myiarchus Lawrencii*, I certainly cannot be justly charged with "scientific plagiarism," since

* The current number of his catalogue.

I present the case in an entirely different light from Dr. Coues, as the following schemes of arrangement will show:

(Coues' arrangement).	*(Ridgway's arrangement).*
6. MYIARCHUS LAWRENCII.	1. MYIARCHUS LAWRENCII (Giraud).
Tyrannus lawrencii Giraud, } Syn.	*a.* var. *lawrencii* Giraud—N. Mexico.
Myiarchus nigricapillus Cabanis. }	*b.* var. *nigricapillus* Caban.—S. Mexico and Central America.
7. MYIARCHUS NIGRICEPS.	
Myiarchus nigriceps Sclater. } Syn.	*c.* var. *nigriceps* Sclater—Panama to Ecuador.
" *brunneiceps* Lawr. }	

Each of the three races which I recognize is characterized by perfectly tangible distinctive features; var. *nigricapillus* is well marked by conspicuous characters which distinguish it from both the others, notwithstanding that Dr. Coues "cannot make out that it is even a recognizable variety." The simple fact that in the series I recognize but one species, with three geographical races, and apply scientific principles in showing the gradual transition from one extreme to the other, and at the same time show the direct relation between this progression and a certain climatic law of color-variation, while he recognizes, in effect, two species, without any varieties, and does not discuss any law or generalization at all, shows how unjust are his pretensions to have anticipated me in this case. These pretensions may, perhaps, be considered the more unjust from the fact that the material upon which Dr. Coues based his monograph of this genus had been previously overhauled by me, thus giving him the benefit of my unpublished determinations, which were in many cases indicated upon the labels —though it is but due Dr. Coues to say that he acknowledged in one case the source of his information (see p. 67, Proc. Acad. Nat. Sci., July, 1872).

I do not claim originality for calling *Picus Harrisii*, "*villosus* var. *Harrisii*," but merely—as any one can see—cite it as an instance illustrating increased melanism toward the Pacific coast. For calling *Sphyropicus ruber*, "*varius* var. *ruber*," however, *I do* claim originality, notwithstanding the fact that this way of "putting it" was first done in the "Key." I well remember, though perhaps Dr. Coues may not, the occasion upon which I unhesitatingly told him of my discovery, and satisfied him of its merit by laying out a series of specimens to illustrate my theory. At that time he certainly had not thought of combining *S. ruber* with *S. varius*, as a geographical race, along with *S. nuchalis*, but the length of time elapsing before the publication of the "Key" (perhaps a

year) no doubt justifies his lack of recollection as to how he got the idea.

The statement in regard to *Cardinalis* is erroneous in several respects: first, I did not make "a new Mexican variety, *carneus*, of *Cardinalis virginianus*," but gave the synonymy of that previously named race, citing Lesson first, and Bonaparte's Conspectus next, as authorities for the name, which I merely reduced to the rank of a race. The new race which I characterized was *coccineus* Ridgway, from eastern Mexico, while *carneus* Lesson was from the western coast. In reducing *C. igneus* of Baird to a variety, I did not follow "a previous writer" (Key, p. 151 cited) since, as explained further on, I had not seen the "Key" until after the printing of my paper.

In the case of the western forms of *Cyanura* I am perfectly willing to renounce all claims to originality, for if my method of treating them contributes to the better understanding of the relation which they bear to each other, my aim is accomplished.

So far as Dr. Coues' "Key" is concerned in the matter of nomenclature, it must in this instance be ignored, as the following facts justify: Though the "Key" was published in October (1872) and my papers not until December and January following, yet I never saw the pages of that work until after the issuing of my papers, which were written and forwarded to the publishers the preceding July or August, at which time I had not seen the "Key" at all. Even had I seen and been perfectly familiar with its pages, I could still claim with perfect right, for reasons stated farther on, originality for the nomenclature which I used.

And now, having justified myself in regard to the relation which my paper held to previous publications in specific points, let me say a few words in its defence on general principles. From the time when its preparation was first discussed in my mind to the time of its publication, the question never once occurred to me whether the laws which I endeavored to explain were my own discoveries, or whether their discovery was the property of others. I took it for granted, that the subject and its general principles were so familiar that a preliminary review of its literature would be a superfluous addition to a paper already overburdened with references — of which, very singularly, my reviewer complains of a meagreness. My only view was to begin at once with these laws, state as precisely and briefly as possible what their prin-

ciples were, and illustrate them, *purely in the interest of science*, by novel cases and, when possible, by the cumulative evidence of familiar cases. If I have succeeded in contributing a few unfamiliar facts to the store of science (and the hope that I have is encouraged by the fact that my reviewer has had the courtesy to approve of the treatment of some cases, and to acknowledge the merit of an occasional novelty) I am much gratified; and consider myself well paid for my labors. To be charged with literary theft must be unpleasant even when it is merited; but to be falsely branded with "scientific plagiarism," without any provocation, is an accusation which cannot be borne in silence. In this case, the charge bears with it so much arrogance, that a simple defence against it is not sufficient; and I should consider myself very selfish and uncourteous did I not make some return for the marked attention which I have received. I therefore deem it my duty to state here, that the several examples alluded to above are but a fraction of the number of cases in which I have suffered from my indiscretion of being too trustingly communicative, and from Dr. Coues having taken advantage of earlier means of publication.

Should my reviewer realize the truth of his preliminary remark, that "the critic's office is not seldom ungracious," I am sure that I feel very sorry that he made up his mind not to "shirk the responsibility" in which the tone, more than the matter, of his criticism involved him.

REVIEWS AND BOOK NOTICES.

ANTIQUITIES OF THE SOUTHERN INDIANS.*—The author expresses the hope that the pages of this volume will, "at least, in some degree, minister to the information and pleasure of those who are not incurious with regard to the subject of American archæology;" and we think in this he will not be disappointed. There certainly is a large amount of valuable information in the twenty-two chapters of the work.

The several works that have now long been the text books of

*Antiquities of the Southern Indians, particularly of the Georgia Tribes. By Charles C. Jones, Jr., 1873. 8vo, pp. 532. Illustrated. Cloth.

North American archæology have all drawn a broad distinction between the so-called mound-builder and the Indian: although in the elaborate monograph of Messrs. Squier and Davis, there is much that belongs either in common to the two races, or the various relics of both have been mixed up. Even as far east as New Jersey, the various forms of relics found in the mounds have been discovered except one class of pottery, and possibly the "animal" pipes.

That the two peoples were not the same—that the present red-man was not the descendant of the mound-builder, has been and is the general opinion, and yet it is difficult, in very many cases, to say of many "finds," *this* is mound-builder and *this* Indian. So the precise relation the two peoples bore to each other is as desirable a problem to solve as to trace out the exact origin of either. It was this latter thought especially that has been suggested by every few pages of the volume before us.

The first nine chapters, giving admirable descriptions of the various mounds in Georgia, recall the many mounds examined by Messrs. Squier and Davis, throughout the Mississippi valley; and we are carried back to the remote time of the occupancy of the country by this mysterious people. Mr. Jones, with his descriptions of the mounds, adds a most admirable account of the manners and customs (as they were) of the Indians, but we ask, Did they build these mounds? The author says, in this connection—"In the light of the Spanish narratives, after a careful consideration of the relics themselves, and in view of all the facts which have thus far been disclosed * * * * we see no good reason for supposing that these more prominent tumuli and enclosures may not have been constructed in the olden time by peoples akin to and in the main by no means farther advanced in semi-civilization than the red-men native at the dawn of the historic period. In a word we do not concur in the opinion, so often expressed, that the mound-builders were a race distinct from and superior in art, government and religion, to the southern Indians of the fifteenth and sixteenth centuries." This is something new in the later speculations concerning the American aborigines, scarcely borne out we think by a careful survey of the antiquities of the whole country. Indeed Mr. Jones himself shows that mound-building races preceded the Indian, and such passages as the following frequently occur,—"The Creeks did not claim that

these tumuli were erected by them. They declared that they were here when their ancestors first possessed themselves of the region." Now if these mounds were deserted by their builders previous to the occupancy of the country by the Creeks or other Indians, it would seem probable that they were a different people. Had they been driven away by the Indian, then the latter would have a traditional recollection of that event. It is not possible to trace any connection, near or remote, between the mound-builder and the Indian; and if the latter were a degenerate offspring of the former, would not some trace of a tradition still remain with them of their ancestors' superiority in art, government and religion?

As the contained relics of themselves go but little way towards elucidating mound history, may not these Georgia mounds have been built by Indians? by some race preceding those that last occupied that territory? for the red-man is certainly given to roving. Like relics do not prove like races, and do like mounds? On this very point, Mr. Squier has expressed an opinion concerning the mounds of New York, which is applicable here. He says of these mounds, that "the resemblances which they bear to the defensive structures of other rude nations, in various parts of the world, are the results of natural causes, and cannot be taken to indicate either a close or remote connection or dependence. All primitive defences, being designed to resist common modes of attack, are essentially the same in their principles, and seldom differ very much in their details. The aboriginal hunter and the semi-civilized Aztec selected precisely similar positions for their fortresses, and defended them upon the same general plan; yet it would be palpably unsafe to found conclusions as to the relation of the respective builders, upon the narrow basis of these resemblances alone." These remarks are applicable here, because we do not yet know what relation these Georgia mounds bear to the unquestionably archaic structures of the Ohio and Mississippi valleys. We still believe that the mound-builders were a different people from the Indians, and had the relics of each been separated and treated of by themselves, we think more light would have been thrown upon American archæology by the first half of Mr. Jones' work.

Chapters x to xxii, inclusive, are devoted to the enumeration and description of the relics found in the mounds and graves and on the surface generally: the latter relics being, as they are in New

Jersey, very numerous on the sites of villages and scattered in fewer numbers wherever game had been followed by the dusky hunters. These relics as a rule differ in no way from such traces of the aborigines found in the middle and northern states. Mr. Jones claims, however, that a greater degree of skill is exhibited in the workmanship, especially of their arrowpoints, by the southern Indians; and we have no doubt but that such was the case to a certain extent: that is, that there is obtained in Georgia a larger percentage of jasper and quartz arrowpoints, which are always more delicately chipped than those formed from softer minerals. We must, however, call attention to the fact that the fifty-three illustrations given do not indicate extraordinary skill, nor have we a drawing of "almost every known form," which the author says "finds here (in Georgia) its type." The most interesting specimens of stone implements figured by Mr. Jones are the sword, pl. xii, fig. 4, the dagger, fig. 3 of same plate, and the axe with stone handle, pl. xii. In our own experience in collecting, we have never met with any relic resembling them; although we have frequently heard of an axe, with a handle of stone, but have always failed to find its present whereabouts. The similarity of our American stone implements to those found in Europe makes the dagger peculiarly interesting, as it renders that form common to the two countries.

In describing the pipes, idols and pottery of Georgia, we think the author has pretty thoroughly confounded Indian and mound-builders' relics. The idols, "animals," pipes and some of the vases, we should consider as belonging to the latter people: while the plainer pipes and fragments of pottery figured are such as are abundant throughout the whole country.

While students of American archæology owe much to Mr. Jones for the vast amount of information he has made accessible to them, by the publication of his interesting work, we think it is to be regretted that the great distinction between mound-builders and Indians has not been admitted by him, for having had an opportunity in Georgia of carefully studying the many traces of each race, the distinction between them, carried out in one volume, would have long been a most valuable guide to those who, in other portions of the Union, may wrest from destruction and preserve to science the rapidly disappearing relics of the ancient peoples of America.—C. C. A.

THE CHILDHOOD OF THE WORLD.*—This tastefully printed little book will not, we think, disappoint those who take it up, provided they expect no more than what the author states in the preface to be its scope and aim, which are "to narrate, in as simple language as the subject will permit, the story of man's progress from the unknown time of his early appearance upon the earth to the period from which writers of history ordinarily begin."

"As the Table of Contents indicates, the First Part of this book describes the progress of man in material things, while the Second Part seeks to explain his mode of advance from lower to higher stages of religious belief."

The first part, which is the shorter of the two, is too brief, and scarcely sets forth the claims of prehistoric archæology to the rank of a science; although the author very properly states the main fact of that science, more than once, *i.e.*, the very great antiquity of man. We think that he is too brief, in this first part, because it is possible he may not have said enough to excite the young reader's attention and curiosity, and so cause him to look further into the subject of archæology, which offers so wide a field for research.

Mr. Clodd believes that man was created *de novo*, and not developed, and starting with that assertion, notices in detail, "Man's first wants," his tools; then fire, cooking, pottery, the use of metals, and then touches upon language, writing, counting, and man's wanderings about the globe; holding throughout, apparently, that all men have sprung from a common origin, which we think by no means demonstrated. At any rate, climate, to which he refers on page 47, and "the land they dwell in," will not of themselves explain the variation now existing between the several distinct types of mankind. Nor can we admit as true, the statement that America was peopled by tribes who "leapt across the narrow straits between Asia and America and wandered over that vast New World." This "leaping across narrow straits" does not appear to us to accord with the traces of archaic man already discovered in this country, as "the contemporaneity of man in America with the mammoth and mastodon may be regarded as being satisfactorily established" and when we go back so far

* The Childhood of the World; A Simple Account of Man in Early Times. By Edward Clodd, F. R. A. S. London and New York: Macmillan and Co., 1873. Crown 8vo, pp. 118. Cloth.

into the past, do we find reason for believing the straits were then as narrow as now? May not an ocean have rolled between, or ice blocked up every portion of the way? In the second part, the researches of Max Müller, Tylor and others as to myths and worship in its various forms, are very clearly outlined, and, we doubt not, will be read with pleasure by all who purchase this little volume. We hope, with the author, that the subjects treated of may rouse a curiosity which will lead to the careful study of the works of Tylor, Lubbock, Nilsson, Waitz and other ethnologists, from which Mr. Clodd has so largely drawn in his brief account of Man in Early Times.—C. C. A.

Catalogue of the Phænogamous and Vascular Cryptogamous Plants of Canada and the Northeastern Portion of the United States.*—This is somewhat on the plan of the British exchange Catalogue which was in use twenty years ago. It is printed in eight pages of large quarto size, each of six columns. The portion of the United States included is co-extensive with that of "Gray's Manual" with the addition of a range of states on the western side of the Mississippi; namely, Missouri, Iowa and Minnesota.

An ingenious arrangement indicates the geographical range of each species, *i. e.*, its occurrence in either or all of three districts, *viz.*: 1, Canada; 2, Virginia; 3, Illinois; respectively representing the northern, the southern and the western distribution. The Catalogue extends to varieties, is very carefully prepared, evidently with much pains, and is admirably adapted for its purpose; that of facilitating exchanges among botanists. Mr. Curtiss, as one of our most active botanists, has doubtless felt the need of what he has now supplied.

Bulletin of the Buffalo Society of Natural Sciences.†—A new life is pervading this society, perhaps due to the removal of Mr. Grote, the well known lepidopterist, from the south to Buffalo. The first number of its Bulletin contains the four following valuable papers on moths by Mr. Grote, which will greatly interest lepidopterists. "Description of New North American

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Moths," "Catalogue of the Sphingidæ of North America," "Catalogue of the Zygænidæ of North America," "Conclusions drawn from a study of the Genera Hypena and Herminia." The second number, which was received by us on Aug. 2d, contains two more plates of moths illustrating two papers by Mr. Grote entitled "Contributions to a Knowledge of North American Moths" and "A Study of North American Noctuidæ." It also contains a paper of thirty-two pages of "Descriptions of New Species of Fungi," by Chas. H. Peck.

We congratulate the society on the very creditable appearance of these two parts of its first volume, and think that it will find this prompt publication of papers read before its meetings of far more value to the authors in the matter of priority than the documents it has sent out regarding them.

BOTANY.

The Fertilization of Grasses.—Prof. Hildebrand, a German botanist who has paid great attention to the subject of the fertilization of flowering plants, has recently made an important series of observations on the fertilization of grasses, and especially of cereals. The agent of fertilization in all grasses, except those few in which the flowers never open, is the wind, insects apparently playing no part in it. With this object the pollen grains are very fine and smooth, so that they are at once dispersed by a breath of air; the filaments are usually not stiff, but versatile, and the stigma is either feathery, or presents a large surface with numerous indentations in which the pollen is easily lodged. These contrivances render cross-fertilization inevitable; and, while self-fertilization is in most cases not absolutely prevented, it is generally rendered very difficult. Many species, however, which are ordinarily cross-fertilized never open their flowers when the weather is cold and rainy, and are, in such circumstances, necessarily self-fertilized. In grasses with unisexual flowers, cross-fertilization must take place as a matter of course. In those with hermaphrodite flowers a few are protogynous, and hence also necessarily cross-fertilized. In the larger number of grasses, however, the male and female organs are developed at the same time, and special contrivances occur for ensuring cross-fertilization. In the rye the position of the organs is such that a part of the

into the past, do we find reason for believing the straits were then as narrow as now? May not an ocean have rolled between, or ice blocked up every portion of the way? In the second part, the researches of Max Müller, Tylor and others as to myths and worship in its various forms, are very clearly outlined, and, we doubt not, will be read with pleasure by all who purchase this little volume. We hope, with the author, that the subjects treated of may rouse a curiosity which will lead to the careful study of the works of Tylor, Lubbock, Nilsson, Waitz and other ethnologists, from which Mr. Clodd has so largely drawn in his brief account of Man in Early Times.—C. C. A.

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Moths," "Catalogue of the Sphingidæ of North America," "Catalogue of the Zygænidæ of North America," "Conclusions drawn from a study of the Genera Hypena and Herminia." The second number, which was received by us on Aug. 2d, contains two more plates of moths illustrating two papers by Mr. Grote entitled "Contributions to a Knowledge of North American Moths" and "A Study of North American Noctuidæ." It also contains a paper of thirty-two pages of "Descriptions of New Species of Fungi," by Chas. H. Peck.

We congratulate the society on the very creditable appearance of these two parts of its first volume, and think that it will find this prompt publication of papers read before its meetings of far more value to the authors in the matter of priority than the documents it has sent out regarding them.

BOTANY.

The Fertilization of Grasses.—Prof. Hildebrand, a German botanist who has paid great attention to the subject of the fertilization of flowering plants, has recently made an important series of observations on the fertilization of grasses, and especially of cereals. The agent of fertilization in all grasses, except those few in which the flowers never open, is the wind, insects apparently playing no part in it. With this object the pollen grains are very fine and smooth, so that they are at once dispersed by a breath of air; the filaments are usually not stiff, but versatile, and the stigma is either feathery, or presents a large surface with numerous indentations in which the pollen is easily lodged. These contrivances render cross-fertilization inevitable; and, while self-fertilization is in most cases not absolutely prevented, it is generally rendered very difficult. Many species, however, which are ordinarily cross-fertilized never open their flowers when the weather is cold and rainy, and are, in such circumstances, necessarily self-fertilized. In grasses with unisexual flowers, cross-fertilization must take place as a matter of course. In those with hermaphrodite flowers a few are protogynous, and hence also necessarily cross-fertilized. In the larger number of grasses, however, the male and female organs are developed at the same time, and special contrivances occur for ensuring cross-fertilization. In the rye the position of the organs is such that a part of the

pollen from one flower must almost necessarily fall on the stigma of another flower. In the wheat each separate flower remains open only for an extremely short time, the glumes separate from one another suddenly, the anthers immediately protruding, and a large quantity of the pollen is dispersed into the air, the whole process not occupying more than half a minute. In most of these cases the stigma remains receptive only for a very short period and then dies, while in others the stigma remains in a receptive condition till long after the anthers have dropped off, and then must necessarily be open to the access of foreign pollen. In comparatively few cases the natural contrivances appear to favor self- rather than cross-fertilization. Thus in the oat and barley the majority of the flowers never open, and are, therefore, necessarily self-fertilized; there appear, however, in almost all cases to be a small number of flowers, often arranged in one or two separate rows, which do open, and therefore may introduce occasional cross-fertilization. It is probable that the same species behaves differently in relation to its arrangements for fertilization under different circumstances of climate, while species very nearly related exhibit phenomena which offer a marked contrast.—A. W. B.

Structure and Propagation of Lichens. — The theory of Schwendener that Lichens are not separate organisms but are composed of Fungi, parasitic on Algæ (the so-called gonidia), has not, up to the present time, found much favor with cryptogamic botanists, Sachs being almost the only physiologist of repute who has as yet adopted it. The theory has, however, recently met with some countenance from the researches of Woronon on the lichens *Parmelia pulverulenta* and *parietina*. He confirms the previous statements of Famintzin and Baranetzky that the gonidia of these lichens produce zoospores which he describes as bi-ciliated; and he gives an exact account of their mode of escape from the gonidia. These zoospores, after the cessation of their vibratile motion, caused by the cilia, become covered by a membrane after the ordinary mode of the zoospores of Algæ, and form themselves into gonidiform bodies, increasing by division, but producing neither filaments nor hyphæ, but only giving birth to new gonidia, in other words, to young individuals of a unicellular alga of the genus Cystococcus. The observation of the actual germination of the zoospores is a link in the chain, hitherto wanting.—A. W. B.

Cleistogenous Flowers in Viola striata. — When we take Gray's Manual, and find no mention of a striking fact, we conclude that what is not known to so excellent a botanist must be new. Yet to me the production of cleistogenous flowers by *Viola striata* is so old a fact that only its omission from the manual leads me now to refer to it.*

The Manual confines the production of these flowers to the acaulescent species which it says "produce apetalous flowers from underground stolons during summer." *V. striata* belongs to the leafy-stemmed section, and produces an abundance of these flowers from midsummer till frost. In early spring the petaloid flowers come out from the axils of the four lowest nodes; six or eight nodes are then formed, in which the axillary bud is developed into a branchlet instead of a flower, and all the succeeding nodes bear leaves with apetalous flowers from the axils, which produce seed very profusely.

Physiologically speaking there is nothing remarkable in this. As suggested in my remarks on *Fragaria "Gilmani"* some years ago, a stolon or runner is but an upright caulis which has lost the power of erection, and characters common to one easily appear in the other with little or no modification.—Thomas Meehan.

Sphagnum and Hypnum Peat. — The opinion seems to have been somewhat prevalent that peat does not accumulate abundantly in limestone regions, but this is not true of large portions of some of the northern interior states. For example, all the peat of Iowa is in an eminently limestone region and the water taken out of any of the marshes shows a strong reaction for lime by proper chemical tests.

From my own observations I believe that Sphagnum peat does not accumulate in limestone regions, but that the peat mosses of such regions all belong to the genus Hypnum. I have found no other moss entering into the composition of Iowa peat.

Another fact observed in this connection has doubtless much significance, namely; the Ericaceæ are almost entirely wanting in Iowa, and no plants of that order have yet been observed by myself in or about these Hypnum marshes. The principal plant assisting the Hypnum in the production of peat is a kind of grass.

Should one go north from Iowa or Illinois into the metamorphic

* It is well known in *Viola canina* of Europe, and here in *V. Canadensis*.—Eds.

regions of Minnesota and Wisconsin, I think he would see the Hypnum gradually give place to Sphagnum in the marshes, and the marsh Ericaceæ appear with the last named moss.

In short, lime seems to be an uncongenial element in the habitat of both Sphagnum and most if not all ericaceous plants, but is not uncongenial to Hypnum and grass. Therefore the abundant presence of lime will not necessarily prevent the accumulation of peat.—C. A. WHITE.

ZOOLOGY.

CENTRONYX "OCHROCEPHALUS" *Aiken*.—This nominal species, described by Mr. Aiken in a recent number of the NATURALIST,* is neither entitled to specific rank, nor even to a name as a well marked variety or race. This deduction I have adopted after a careful examination of the two specimens of it collected—one, the type, in the museum of the Smithsonian Institution, the other in the collection of Mr. R. Ridgway — and their comparison with Audubon's type of *C. Bairdii*. The color differs in the two types very appreciably. indeed as much and even more, than in many well established and closely allied species: but while the specific distinctness of these is sustained by large series of specimens in which there is scarcely any gradation, or a too close approximation in coloration, the validity of the *C. "ochrocephalus"* is entirely overthrown by the second specimen obtained, which is exactly intermediate in color, as it is in season of collection, between the first and the single specimen of *C. Bairdii*. The emarginate tail of Aiken's sparrow, as compared with the doubly rounded one of Baird's, has little weight as a character. The *C. Bairdii* undoubtedly possessed this feature, as is apparent from the appearance of the plumage, which everywhere exhibits a worn and bleached surface: and in some places the vanes at the tips of the feathers are worn quite off from the shafts; this is especially noticeable in the rectrices. The most cogent reason for considering it distinct from *C. Bairdii* lies in the differences in their relative size and proportions—*C. "ochrocephalus"* being considerably the larger; but, even in this, it does not exceed the proportion of variation which should be recognized as occurrent in a species.

*Vol. vii, p. 237, 1873.

In regard to the new thrush (*Harporhynchus Bendirei*) recently described by Dr. Coues,* it is probably identical with Mr. Ridgway's var. *Palmeri*.

The maximum number of species in the genus Harporhynchus was undoubtedly reached some time ago: and an enthusiastical Darwinian could be censured but mildly for considering the series as representatives of a single species, the most aberrant forms being looked upon as incipient species.—DAVID SCOTT.

WHO FIRST DETERMINED THE TRUE POSITION OF HYALONEMA.—While sympathizing with the spirit of Mr. Chapman's criticism of Prof. Thomson in the current August number of the NATURALIST, we must say that he is not quite correct when he asks: "Why therefore does he [Dr. Thomson] unjustly ignore the fact that Dr. Leidy was the first to describe correctly the position of Hyalonema, by saying we had been looking at the sponge upside down, and that it had never occurred to any one to reverse it?" Dr. Leidy's article is in the NATURALIST, Vol. iv. This was in January, 1871. Doubtless Dr. Leidy's article was written the year before. In the NATURALIST, Vol. iii for 1870, is an interesting review of Scandinavian work in Natural History done in the years 1867–8. On page 216 in reference to Prof. Lovén occur these words: "the same celebrated author's ingenious memoir on the little stalked pyriform deep-sea sponge, from Finmarken, termed *Hyalonema boreale* Lovén, by means of which he demonstrated that the Lusitanian and Japanese glass-ropes had hitherto been erroneously represented as if turned upside down." In the article on "The Glass Sponges," in the "Popular Science Monthly" for this month, I have endeavored to do justice in this matter to all concerned.

In regard to Prof. Lovén's *Hyalonema boreale*, it should be mentioned that C. Wyville Thomson in his book, p. 113, says: "It is certainly very far from *Hyalonema*. It is more nearly allied to *Tethya*, for the body of the sponge must certainly be referred to the corticate type, though it differs from all the other known members of its order in being supported on a long symmetrical stalk formed, as Professor Lovén has shown, of sheaves of short spicules bound together by horny cement." But this in no wise affects the soundness of the Professor's demonstration.—S. L.

*American Naturalist, Vol. vii, p. 330, 1873.

PASSAGE OF SPECIFIC CHARACTERS FROM ONE GENUS TO ANOTHER. —I find among the *Acrididæ* from the west a case which would seem to go far toward confirming the opinion of Prof. Cope, that often specific characters pass over from one genus to another.

The *Acrolophitus hirtipes* Thos. (*Gryllus hirtipes* Say) forms a very distinct and somewhat peculiar genus; the specific characters are also very distinct and well marked. During my connection with the United States Geological Survey, in charge of Dr. F. V. Hayden I have frequently met with this species in Colorado, northern New Mexico, and Wyoming, but nowhere else in those territories or in northern Utah, Idaho, Montana, Nebraska, Kansas or Dakota have I met with any closely allied species. Recently the Orthoptera collected by Lieut. Wheeler during his Explorations in Arizona have been submitted to me for examination; in that collection I find specimens which, in specific characters including even color, agree exactly with *A. hirtipes*, but differ in two prominent generic characters.

In Acrolophitus the chief generic characters are, an erect, conical vertex (which alone distinguishes it from all other American species of *Oedipodini*); a sharp elevated crest on the posterior lobe of the pronotum; posterior margin of the pronotum acutely angled. The species collected by Lieut. Wheeler has the erect, conical vertex, but the pronotum is without a crest or even a medium carina, and the posterior margin is obtusely rounded, yet the general form, size, etc., even to the hairs on the legs, are the same in both species; the color is exactly the same throughout.—C. THOMAS.

OCCURRENCE OF THE ROCK WREN IN IOWA.—*Salpinctes obsoletus*, not previously found east of the Rocky Mountain region, was observed by the writer last fall in Decatur county, Iowa. It was seen on several occasions, far out on the prairie, running over the ties on the railroad track, retreating when alarmed, into the dense prairie grass.—T. M. T., *Garden Grove, Iowa.*

MICROSCOPY.

APERTURES OF OBJECTIVES.—It is now certain that nothing can be easier than to get more than 82° of rays through a balsam object and immersion objective, and that those accomplished microscopists who maintained the contrary were in error in resting

their mathematical argument upon the improved assumption that the conditions under which the law of reduced apertures operated were, and must necessarily be, the same in all objectives as in those which were in their hands. This fallacy in the mathematical argument has been already pointed out in this Journal, as well as by Dr. J. J. Woodward in the "Monthly Microscopical Journal." Now that the doctrine of the limitation of the balsam angle of objectives, plausible and strong in seeming to rest upon well known facts, is removed from the way of progress in the science it was designed to assist, it remains to discuss the means of accomplishing an increase of this angle, and whether such increase may add to the working qualities of the objectives possessing it. Mr. Tolles, who must be admitted to have been the first to claim such increase of angle, believes it to be a valuable addition to the powers of objectives. The following letter from him contains some further discussion of the means of increasing the balsam angle, as well as some claims in regard to his personal relation to the controversy.

DR. R. H. WARD, *Sir*:—I have read your notice, in the July Number of the NATURALIST, of a current discussion as to possible balsam angular aperture of objectives. I am gratified at its evident spirit of fairness; and will ask that, in the same temper, you will give place to some strictures of my own.

The $\frac{1}{10}$ measured in London had, and has, no point of adjustment where with appropriate cover thickness the definition would not be good. Its highest angle, when immersed in water, is about midway of the total adjustment, and at this point corrects for $\frac{1}{75}$ inch cover. All this I will show you any time; also, Dr. J. J. Woodward has verified the same.

There is no secret as to the mode of action and the plan. The theory has been openly declared in every article of mine having the form of reply to Mr. Wenham since his first denial of validity of my first "experiment." Thus, while admitting and declaring the reduction of refraction at the first plane surface, by immersion in a more refractive medium than air, every suggestion on my part has been of *some way of making up for that loss.* You say I appeal to facts not discussing principles. What induced my first experiment was a clear apprehension of law, and the result was confidently asserted beforehand. I have never denied that the air

angle of (close to) 180°, after the first refraction, was necessarily reduced to 82° (closely) by crown glass plane surface, and by heavy, flint plane surface to 76° (closely). That is and has been understood, all around; though produced and constantly reiterated as an answer to my claims, not only by Mr. Wenham, but volunteered with much rudeness from another quarter.

You comprehend the case perfectly when you say, "This reasoning assumes only that the extreme ray above the front combination, capable of entering into the image when the objective is worked dry, is the extreme also when adjusted for immersion work." But it would be equally true to say, "the extreme ray above the front" *surface* "is also the extreme ray, etc." In the light of this statement, what is to be understood by my March paper (Monthly Microscopical Journal, 1873) to which you allude as "practically disclaiming this doctrine of rays beyond the extreme rays dry?" Why, I suggest the one sure way of giving entrance from the denser medium into the Front of a larger pencil than before with crown glass, in just so far as the refraction of the Front in such medium approaches the refraction of crown glass in air; and, behold! I am made to disclaim the very thing I have just done and pointed out how. However, from what you have written I know *you* will understand this: — my respondents say at once, "82° impinging on the inner front surface of the front lens will, from crown glass, emerge into the balsam without sensible deviation." Now, suppose we use flint glass; the angle at which total reflection takes place in this, when in contact with air, is not 82° (–), but 76° (about). When a pencil of 82°, however, impinges upon this plane surface of flint, in contact with balsam, it will have positive refraction according to the refractive index of flint glass *in balsam* and therefore while only 82° *in the glass* of the flint front, whether emergent or immergent would have more than that angle in the balsam. This much at least is sure and is decisive of the question. But again, if the material of the *front surface* have a refraction *in balsam* equal to that of crown glass in air, then obviously we *might* have near to 180° in the balsam, while the transmitted pencil immediately above the front surface would remain about the same as the "limiting angle" of crown glass in air, viz.: 82.° This is valid principle and reasoning, but I cannot appeal to facts in this case. The best I have done is 112° in balsam. See "Monthly Microscopical Journal" for June, 1873.

Do not suppose that this is the only way to exceed 82° in balsam practically. The 100° $\frac{1}{5}$ objective of four systems was on quite a different plan. It is, as to plan, described in the "Monthly Microscopical Journal" for March, 1872. There the inner three systems have 130° as a dry objective, the front as applied to those three serving only to admit such a pencil to the dry objective constituted of the inner three. But the $\frac{1}{5}$ tested by Dr. Woodward has, as to the inner three, an angle of 105° in air, and, as they are used, while the front has some, but slight, influence upon the pencil passing through it.

And now, to sum up, referring to my article of March, 1872, "Monthly Microscopical Journal," and diagrams. I will quote Fig. 1 and explanation as *theory*, antecedent to *fact*. The four-system objective being subsequently made and authoritatively re-substantiating the theory. (See "Monthly Microscopical Journal" for June, 1873; paper by Dr. Woodward giving the angle as 100° in balsam.) Quoting again, as to the case of the three systems, same Journal, same page, referring to Fig. 2. "What is intended is to increase the refraction of the convex surface of the front by sharper convexity, or higher refractive material, or *both*, to the extent necessary to make up for the diminution at the plane surface according to the refractive power of the medium" in which the front surface is immersed. Now the results, according to this second case, are well attested for angles considerably above 82° in hard balsam; account of all which will appear in good time for support of my theory! *i. e.*, the universally accepted theory. For balsam of refractive index the same as common crown or plate glass I will, with pleasure, show to you at any time that the angle of the $\frac{1}{10}$ objective, tested in London, is at least 90°; and *that* is the kind of balsam Mr. Wenham has constantly talked of, witness each of his criticisms on my claims. Every time he has alluded to the balsam index, he has declared it practically the same as crown glass. Of course, when hardened to resin, it may have higher refractive index and reduce the angle a little. Hence certain discrepancies as to amount of angle above 82°. For this reason, I have used the semi-cylinder, but that has, and had, another and a superior purpose. As a means of getting the actual angle, and the crucial test to decide this discussion, a much simpler method will serve. Thus, any piece of plate glass, say an inch square or upwards, and perhaps $\frac{1}{10}$ inch thick, or more or less, one

or both plane surfaces fine ground, is all that is necessary, only, be it provided, that some part of one edge be a polished or fractured surface tolerably near flat and square. Use this precisely as Dr. Woodward uses his tank, and the angle of the objective for that kind of balsam (like the glass) will be indicated along the ground surface if a little care be taken in adjusting glass to objective. Balsam, glycerine or dense oils will do to connect the objective front and glass plate, for the pencil traversing the plate will be constantly the same for a wide range of "preservative media." This cone can be marked as to its boundaries with a pencil on the ground glass, and measured with a protractor with perfect facility.

Whatever position gentlemen respondent may take now, *pro* or *con*, the end is assured, viz., a practically larger angular aperture for objects in balsam. I hope you will award these comments an insertion. Respectfully yours,

ROBERT B. TOLLES.

40 *Hanover Street, Boston, Mass.*

P. S. — Since writing the above, the "Monthly Microscopical Journal" for July, containing Mr. Wenham's reply to Dr. Woodward's article, has come to hand. I notice Mr. Wenham recommends the same ground glass plate for test of angle that I describe above, only nothing is said of connecting media. This is excellent! With air between, the cone will, with crown or plate glass, be about 81°, but if water or balsam or any known liquid replaces the air it can be more. It is the test. Some objective will be found in England, I dare say, to go above 82°.—T.

MICROSCOPICAL EXPERIMENTS WITH INSECTS' EYES.— Dr. F. W. Griffin, of the Bristol School of Chemistry, gives in the "World of Science" and in the "Monthly Microscopical Journal," an interesting note on this subject. Any tolerably mounted beetle's eye (transparent) will give some of the desired effects; but for good results the semi-globular set of "lenses" which constitutes the outer part of the compound eye should be very carefully cleaned and flattened without materially altering the form of the individual lenses. This is arranged as a transparent object under a one inch objective, and preferably a "Kelner" eye-piece, when some two thousand lenses or corneules are brought into view at once. By racking the objective up, the focus of these little lenses

is found, slightly above their surface, and in the focus of each is seen the image of an object, as for instance a fly on the point of a pen, held between the stage and the mirror. By a little ingenuity a good view can be obtained of a blind-tassel, the profile of a person standing before the window, or even of a landscape outside; though these distant and difficult objects show better by using a $\frac{1}{4}$ inch objective and a one inch lens as achromatic condenser. A swinging tassel, or a profile cut in brown paper and fastened against the glass, or a person's hand with the fingers in motion, or a watch face with the second hand in motion, are among the curious or grotesque objects that may be seen multiplied hundreds of times in the beetle's eye. When lamplight is used, it must be rendered parallel by the bull's-eye, and for really good effects the concave mirror and one inch achromatic condenser must also be used.

Binoculars for High Powers. — Mr. Wenham, finding the various non-stereoscopic binoculars unsatisfactory, and finding it inconvenient to make and mount a reflecting prism which should come sufficiently near the lenses to be efficient with the highest powers, has revived the achromatic refracting prism suggested by him to the Microscopical Society on June 13, 1860, by which the rays from each lateral half of the objective are bent towards the axis of the tube, crossed, and sent to the opposite eye of the observer. The prism, representing really two prisms cemented back to back, is made so small and mounted in so thin a tube that it can be slid down into the mounting of the objective close to the posterior lens.

Structure of Eupodiscus and Isthmia. — Mr. Henry J. Slack has communicated to the Royal Microscopical Society some important researches on this subject, tending to confirm his previous impression that in all diatoms the silicious deposition takes place in spherules of varying dimensions and arrangement. He entirely discards such terms as "areolæ," "cellules," etc., believing that such apparent structures are merely, and always, unresolved groups of variously aggregated spherules. This structure he has demonstrated, and has repeatedly confirmed on Pinnulariæ, but with the old means of investigation he failed on Isthmia and Eupodiscus. With Mr. Wenham's new "Reflex Illuminator," however, these easily fall under the same law, the circular valve of *Eupodiscus*

Argus being composed of radiating bands of minute and closely packed spherules with intervening rows of clusters of larger spherules usually in fours, and *Isthmia enervis* revealing, in the place of its familiar reticulated appearance, an aggregation of minute spherules at different levels but of, as yet, not well determined arrangement. A Beck's $\frac{1}{5}$ objective will reveal this structure, though a $\frac{1}{8}$ is preferable; Powell and Lealand's new pattern (dry front) giving it excellently.

On the other hand, Mr. Samuel Wells of Boston, who has studied *Eupodiscus Argus* without the reflex illuminator, perceives no spherules and explains the usual appearances without them. The outer or convex surface he finds clear and smooth, except that it is irregularly dotted with depressions about $\frac{1}{8000}$inch in diameter and extending nearly through the thickness of the valve. This appearance is verified by the binocular microscope and by sectional views obtained from broken valves, and is not varied by any change of power or illumination. The concave surface, which Moller mounts upwards and which alone was probably studied by Mr. Slack, is nearly smooth, without ridges and probably without granulation. It is covered with irregularly radiating rows of round dots with intervening blank spaces. These dots are about $\frac{1}{20000}$ inch in diameter, and with a $\frac{1}{10}$ or $\frac{1}{20}$ and Prof. H. L. Smith's apparatus for opaque illumination, they appear to be slight depressions with the bottom slightly convex; the four or more which are over each of the depressions on the other side of the valve being naturally brighter than the others, and corresponding to the groups of larger spherules of Mr. Slack.

Mr. Charles Stodder also combats the doctrine that the silicious matter in diatoms is always deposited in the spheroidal form. He still believes that the markings on ordinary diatoms are depressions and not elevations, and that the line of fracture is inclined to run through them instead of between them, and he therefore retains the terms "cellules," "areolæ," etc. His account of *Eupodiscus Argus* is so much like that of Mr. Wells, though published independently, as to suggest the explanation that they have worked at the subject together. He finds two silicious coats, the outer comparatively opaque and marked with large, thin apertures through which could be seen the inner coat with its much finer markings which vary according to focus and illumination from a spherical to a cellular appearance, and from a radiated to an irreg-

ular arrangement. Mr. Stodder used Tolles $\frac{1}{10}$ with Prof. Smith's opaque illuminator and Tolles $\frac{1}{18}$ immersion, and he is convinced that some parts of the valves are smooth, transparent, and structureless, without a trace of spherules.

NOTES.

We print in this number the proceedings of the first meeting of the Agassiz Natural History Club, organized by the students of the Anderson School of Natural History at Penikese Island. The school was, notwithstanding the unfinished state of the buildings, and many other temporary drawbacks, resulting from its isolated situations, opened on the 8th of July, fifty students being present. As we go to press the indications are that the need of such a school has been fully demonstrated, and its future success thoroughly assured. The nature of the work already done is such as will tend to make each student an original investigator. A large proportion of the members are teachers. They are learning the art of observing for themselves, gaining an insight into the modes and difficulties of research and obtaining some idea of the vast extent of the field of biology. Even after the short term of ten weeks they will return to their schools and colleges with a new enthusiasm for science-teaching, which will inevitably, if we mistake not, be shown in the other studies they may have to teach.

Though the school, at the time of writing this note, has been running but a fortnight, lectures on surface geology, the embryology of vertebrates and articulates, on physiology, physical geography, on the microscope and its construction, with practical lessons in its use, free hand drawing on the blackboard, zoological and landscape drawing, and daily dredging excursions in the yacht "Sprite," together with instructions in collecting and preserving animals, have been given. The amount of laboratory work done is most satisfactory. Large aquaria are being set up in the temporary laboratory, while the walls for the second dormitory and laboratory are going up.

Certainly the most sanguine friends of the movement have every reason to congratulate the founder and director of the school, with those associated in the work of teaching, on the good prospects of the experiment.

Proceedings of the Agassiz Natural History Club.—The first meeting of the club was held July 24, 1873. President S. F. Whitney in the chair.

Professor Agassiz, having been invited by the President to favor the club with remarks and advice concerning the best methods of work, responded very pleasantly.

Mr. E. C. Crosby read a short paper upon the genus *Bufo*. The eggs of two specimens examined numbered 8840 and 2200 respectively, counted under a lens magnifying four times. All appeared black to the naked eye, but the lens showed half of them to be ashy-brown. With a power of 75 diameters, the eggs were seen to be spherical in shape and of various sizes; the interior of each of a lighter color than its exterior. The stomach of one toad contained eight orthopterous (Locustariæ and Gryllidæ) insects and fifty-three Amphipod crustaceans with much dead grass-like matter. Some of the crustaceans were alive and moving in the stomach. The intestine and the oviduct were each sixteen inches in length. Reference was also made to the great comparative size of the femoral muscles in this genus.

Mr. C. S. Minot said he also had noticed that in toads caught near the beach, the stomach was filled with *Gammarus ornatus*. In two specimens caught early in the morning the sand-fleas in the anterior part of the stomach were still alive; in others caught just before noon they were all dead. He had also observed that in all the toads killed by chloroform, the heart continued beating, after death; while just the opposite effect occurred in mammals.

Dr. Wilder stated that when turtles and toads were killed with benzine the hearts would beat for several hours, although it, like chloroform, always stops the action of the heart with mammals; in one case a *Chysemys picta* was left for eighteen hours in a jar with an excess of benzine, yet the heart beat for several hours after the animal was opened.

Dr. Wilder also suggested that the depth (2 to 5 inches) of the hole in the turf, in which the toads are often found secreted during the daytime, might be for the sake of protection from the salt spray which must often sweep an unwooded island.

He further remarked upon the absence of any mollusks in the stomachs of those hitherto examined, although multitudes of small Littorinas are left upon the seaweed and among the stones where the Gammaroids occur.

Mr. C. S. Minot presented specimens of stratified sand and other soils from Nashaurna Islands. The remarks called out by this item caused a digression to the subject of glacial scratches upon which Prof. Agassiz made a few suggestions.

Mr. Straight offered a note upon the *Supinator longus* muscle of vertebrates. According to both Meckel and Huxley, this muscle is not found in dogs. Huxley mentioned it with a list of muscles which are generally represented in the vertebrates above fishes and which are well developed in man. Meckel names various of the mammalia in which it is found, but says it is absent in bats, the hyena, dog and some others. In dissecting the muscles of the forearm of a Newfoundland dog, July 19th, his attention was attracted by a peculiar strip of muscular fibre, scarcely three-eighths of an inch in width. In tracing it out to its distal end it was found to terminate in a small tendon, fully one-fourth the length of the entire muscle. Judging from the position of this small muscle Prof. Wilder unhesitatingly pronounced it the rudiment of the muscle known to anatomists as the "Supinator longus." It was so small that it would have been of very little if any use to the dog. It will be of interest to ascertain in what races of dogs this muscle is present, and in what absent, as we must admit it was absent in those dogs examined by Meckel and Huxley.

The President hoped that sometime the club would possess a library of reference and a cabinet for comparison. Prof. Agassiz explained in reply, that by the terms of Mr. Anderson's gift, it was possible to make the library and collections of the Museum at Cambridge, at some time, available to the Anderson School.

Professor Fernald made some interesting statements on the habits of *Crepidula formicata* Lam., upon being irritated.

Miss Shattuck reported the addition of *Betula alba*, var. to the list of the flora of the island.

Is it not a little strange that we should not have in this country a first class zoological garden? The nearest approach is the collection of animals in the Central Park, New York. Between April 1, 1870, and April 1, 1871, there were about 175 animals in this collection; they were placed in a series of buildings which surround the Museum and comprise one for the carnivora, one for the birds and monkeys, open air sheds for the bears, wolves, etc., roomy and open air cages for the eagles, domestic fowls, etc.,

and an enclosed building for the elephants, camels, and various tropical animals.

PROFESSOR MARSH, with a large scientific party from Yale College, left New Haven June 5th to continue his researches in vertebrate fossils in the Rocky Mountain region. A successful trip to the pliocene beds of the Niobrara river has already been made and the party are now exploring the eocene deposits near the Uintah Mountains. They will probably not return east before December.

ANSWERS TO CORRESPONDENTS.

H. W. H., Penn.—The plants sent for examination are as follows: No. 1. *Osmunda regalis* L.; No. 2, *Asplenium pinnatifidum* Nutt.; No. 3, *Melilotus alba* Lam.—R. H. W.

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